CHAPTER 2

PROJECT PLANNING AND MANAGEMENT

LEARNING OBJECTIVE: Recognize the elements required to plan, manage, execute, and monitor a construction project using precedence diagrams and barcharts, Identify the techniques for estimating man-hours and material, establishing safety responsibilities, and closing out a project.

Good construction planning and estimating procedures are essential to the ability of the Naval Construction Force (NCF) to provide quality construction response to the fleet's operational requirements. This chapter contains information that you can use in planning, estimating, and scheduling construction projects normally undertaken by the Seabees.

CONSTRUCTION MANAGEMENT

After World War II, the construction industry experienced the same critical examination the manufacturing industry had experience 50 years before. Large construction projects came under the same pressures of time, resources, and cost that prompted studies in scientific management in the factories about the year 1900.

The emphasis, however, was not on actual building methods, but upon the management techniques of programming and scheduling. The only planning methods being used at that time were those developed for use in factories. Management tried to use these methods to control large construction projects. These techniques suffered from serious limitations. The need to overcome these limitations led to the development of network analysis techniques.

In the late 1950s, a new system of project planning, scheduling, and control came into widespread use in the construction industry. The critical path analysis (CPA), critical path method (CPM), and project evaluation and review technique (PERT) are 3 examples of about 50 different approaches, The basis for each of these approaches is the analysis of a network of events and activities. The generic title of the various networks is network analysis.

The network analysis approach is now the accepted method of construction planning in many organizations. Network analysis forms the core of project planning and control systems.

Construction management in the Seabees is based on the CPM. A major advantage to using the CPM method is training. CPM gives the new project supervisor exposure to the fundamentals of project management. These fundamentals can be broken down into the following steps:

1. **Develop construction activities.**

   After careful review of the plans and specs, your first step is to break the job down into discreet activities. Construction activities are generally less than 15 days in duration and require the same resources throughout the entire duration.

2. **Estimate construction activity requirements.**

   Evaluate the resource requirements for each construction activity. Identify and list all of the materials, tools, equipment (including safety-related items), and manpower requirements on the Construction Activity Summary (CAS) sheet.

3. **Develop logic network.**

   List the construction activities logically from the first activity to the last, showing relationships or dependencies between activities.

4. **Schedule construction activities.**

   Determine an estimated start and finish date for each activity based on the sequence and durations of construction activities. Identify the critical path. This will help focus management attention on those activities that cannot be delayed without delaying the project completion date.

5. **Track resources.**

   As the crew leader, you must be sure the necessary resources are available on the project site on the day the work is to be performed. For materials on site, this will be as easy as submitting a material request, NAVSUP Form 1250-1, to the material liaison office (MLO) several days in advance. For local purchase requirements, such as a concrete request to MLO, a request may be required 2 to 3 weeks in advance.

6. **Control resources.**

   As the crew leader, you are also responsible for on-site supervision of all work performed. Productive employment of available resourees to accomplish assigned tasking is your greatest challenge.

OPERATIONS DEPARTMENT

An understanding of the operations (Ops) organization and its responsibilities in the planning and execution of construction tasking is necessary before any further discussion of project management. You can refer to figure 2-1 for a clear picture of the organization.

Operations Officer (S3)

The S3 has functional authority over the construction and disaster preparedness programs in the battalion. In this capacity he or she has direct supervisory authority over the line companies. The S3 reports directly to the commanding officer. The S3 is responsible for the assignment of all construction resourees: personnel, equipment, tools, and materials. Since the project planning process involves allocating these resources to specific projects, the S3 controls the project planning process, oversees each planning phase, and approves all final project packages.

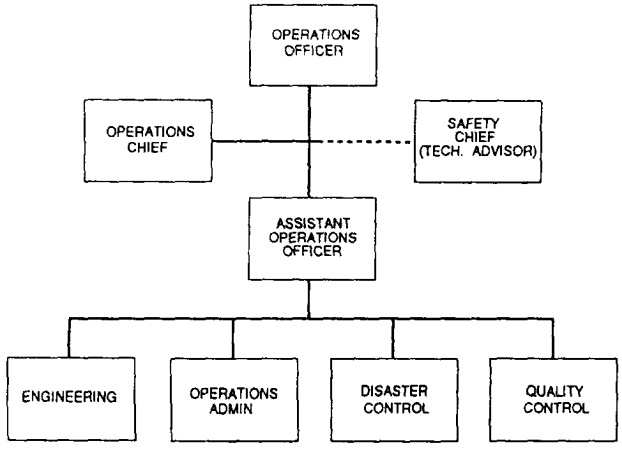


Figure 2-1.—Operations department organization.

Assistant Operations Officer (S3A)

The S3A is generally responsible for the administrative/executive efforts and record keeping of the Ops department. The S3A acts for the Ops officer in case of his or her absence.

Operations Chief (S3C)

The S3C is normally responsible for the day-to-day coordination of personnel within the department and assists them in carrying out their duties. The S3C also assists crew leaders through daily visits to the jobsites and generally assigns E6 and below OF-13 personnel within the battalion.

Engineering Division

The engineering division provides a variety of engineering services including surveying, concrete slump and strength tests, compaction tests and drafting. Engineering also maintains the "as-built" drawings for projects under construction.

Operations Administration

In addition to typing operations reports such as situation reports (SITREPs), the Ops admin staff also provides centralized timekeeping and personnel distribution status.

Quality Control (QC) Division

The QC division is staffed with a group of highly skilled technicians capable of instructing personnel to perform the work in the plans and specifications. These technicians are normally included in the planning and estimating and deployment planning groups. They have detailed knowledge of all facets of a project and are knowledgeable on the critical inspection items that must be followed for each network activity during each phase of construction. This group of technical experts, as agents of the Ops officer, is the group within the battalion most capable of resolving field problems with the individual construction units.

The QC division develops a QC plan intended to be a single-source document. This document outlines

the command policies and the detailed methods of implementing, administering, and monitoring construction to ensure the highest quality product. In all aspects of construction work, the battalion is considered to be a contractor who works with and through the officer-in-charge of construction (OICC), engineering field division (EFD), resident officer-in-charge of construction (ROICC), or the individually designated customer representative to accomplish the project.

All construction work done by the battalion is according to the construction quality control (CQC) program. This construction work is outlined in the P-445, Construction Quality Control Manual, and various implementing instructions provided by EFDs, OICC and ROICC offices, and COM2NDNCB/ COM3RDNCBINST 4355.1 series.

PRELIMINARY DEPLOYMENT PLANNING

Planning for construction tasking begins approximately 10 months before deployment when the battalion receives the tentative tasking message. Many decisions must be made before the crew leader can begin detailed project planning. Most of these decisions are among the following:

1. **Officer/Chief Petty Officer Assignments —** announced by the commanding officer.
2. **Safety/QC Staff Assignments — announced** by the Ops officer.
3. **Detachment Manning** — announced by Ops with input from detachment OICs, assistant officers in charge (AOICs), and company chiefs,
4. **Prime/Subcontractors** — assigned by Ops. The prime contractor is responsible for the safety, quality, and timeliness of the construction effort and directs subcontractors accordingly. The subcontractor is responsible for assigning resources in sufficient quantity and quality to accomplish their portion of the project according to the coordinated schedules. Figure 2-2 shows the prime/subcontractor organization and the line functional authority in execution of construction tasking.
5. **Crew Leaders** — nominated by company commander/detachment OIC and appointed by Ops.
6. **Planning and Estimating Team** — must include members of both the prime and subcontractor crews. Crew leaders must work with their chain of command to have their crews identified as early in home port as possible. After the crews are assigned, planning effort can be scheduled around the planning milestones.

DETAIL PROJECT PLANNING

The entire history of each NCF project, from the initial planning phase through the execution phase to the closeout phase, is documented in a standard

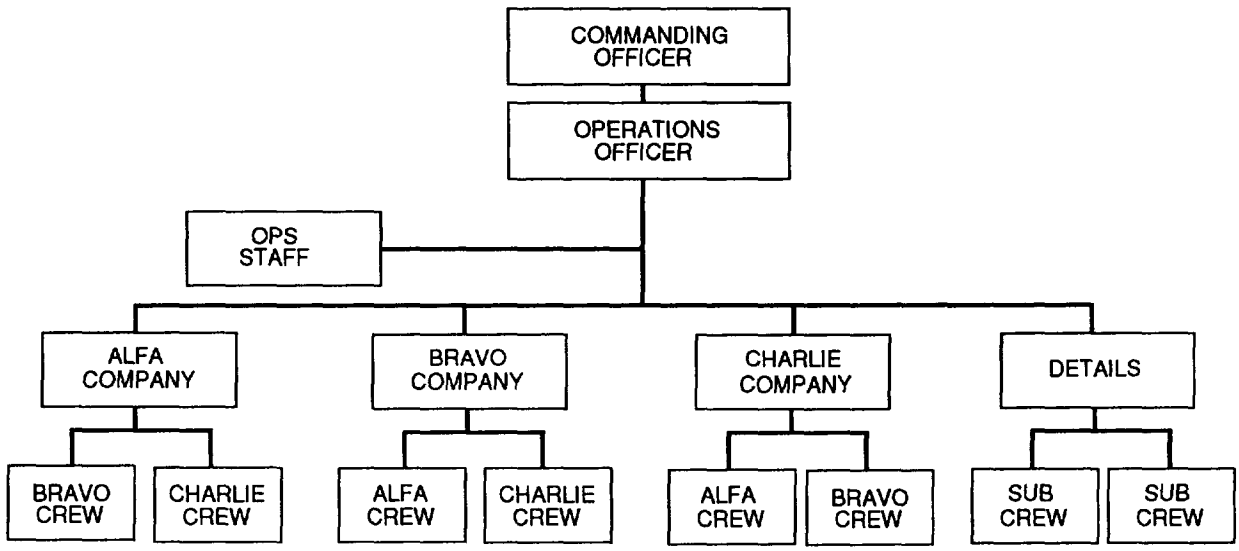


Figure 2-2.—Construction organization.

STANDARD NCF PROJECT PACKAGE OUTLINE

FILE #1 GENERAL INFORMATION FILE

LEFT
- Project Scope Sheet
- Tasking Letter
- Project Planning Cheek List
- Project Package Sign-Off Sheet

RIGHT
- Project Organization
- Deployment Calendar
- Preconstruction Conference Notes
- Predeployment Visit Summary

FILE # 2 CORRESPONDENCE FILE

LEFT
- Outgoing messages and correspondence

RIGHT
- Incoming messages and correspondence

FILE # 3 ACTIVITY FILE

LEFT
- Constrution Activity Summary Sheets of completed activities

RIGHT
- Master Activity Summary
- Level II
- Level II Precedence Diagram
- Master Activity Summary Sheets
- Construction Activity Summary Sheets (Recommend Including filled out 1250s and mineral products requests.)

FILE # 4 NETWORK FILE

LEFT
- Computer Printouts
- Level III Precedence Diagram

RIGHT
- Resource leveled plan for manpower and equipment
- Equipment Requirement Summary

FILE # 5 MATERIAL FILE

LEFT
- List of Long Lead Time Items
- 45-Day Material List
- Material Transfer Requests
- Add On/Reorder Justification Forms
- Bill of Materials/Material Take-Off Comparison Worksheets
- Material Take-Off Worksheets

RIGHT
- Bill of Materials (including all Add-On/Reorder BMs)

FILE # 6 QUALITY CONTROL FILE

LEFT
- Various Quality Contnrol Forms
- Field Adjustment Requests (Design Change Directives)

RIGHT
- Daily Quality Control Inspection Reports
- Quality Control Plan

FILE # 7 SAFETY/ENVIROMENT FILE

LEFT
- Required Safety Equipment
- Stand-Up Safety Lectures
- Safety Reports Accident Reports

RIGHT
- Safety Plan Highlighted EM 385
- Environmental Plan (if applicable)

FILE # 8 PLANS FILE

LEFT
- Site Layout
- Shop Drawings
- Detailed Drawings (if required)
- Rebar Bending Schedule
- Form Material Worksheet

RIGHT
- Project Plans

FILE # 9 SPECIFICATIONS FILE

LEFT
- Technical Data

RIGHT
- Highlighted Specifications

Figure 2-3.—Standard NCF project package outline.

nine-folder project package. Figure 2-3 is an outline of the standardized NCF project package. You will use this format on all tasked projects. The forms for each file may be obtained from the regimental operations department. A flowchart showing the sequence of planning steps is provided in figure 2-4. We will examine the planning sequence and see how the project package is created step by step. These steps also are listed in the project planning milestones list in figure 2-5. Planning milestones should be assigned by Ops at the beginning of home port.

REVIEWING THE PLANS AND SPECIFICATIONS

A thorough review of the plans and specifications are absolutely necessary. Figure 2-6 provides a checklist for this review. In addition to the checklist items, many questions, such as those in the following list, must be answered:

- **Scheduling**

  What is the scheduled progress at turnover?

  Is sufficient time allotted?

  Will long lead-time materials be available?

  Is work required in occupied buildings?

  Is roofing, sitework, or other weather-dependent work to be done in the rainy season?

  Do the specifications require phasing of work?

- **Site conditions**

  Are there any hazardous materials present (such as asbestos floor tile, siding, roofing, insulation)?

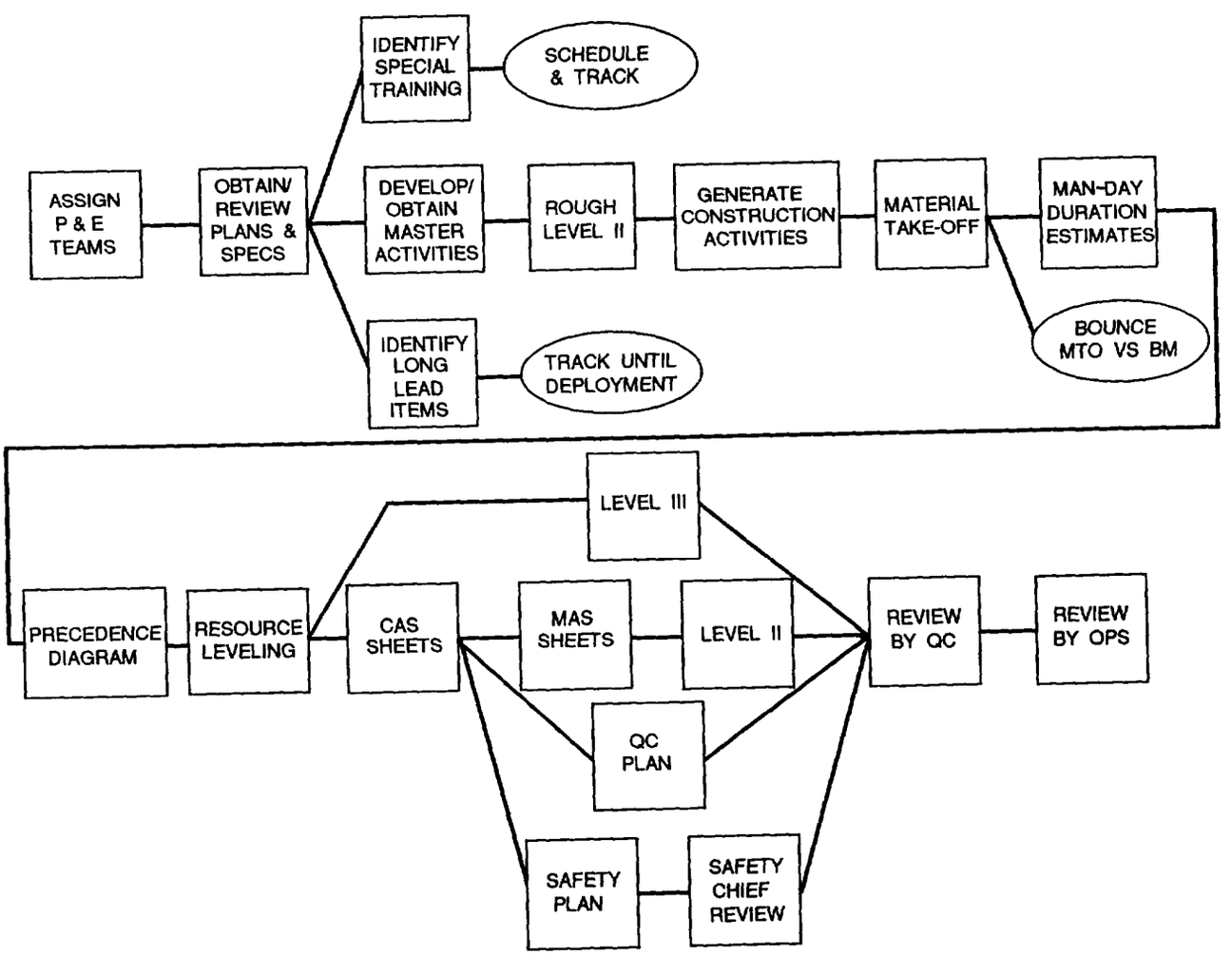


Figure 2-4.—Project planning flowchart.

PROJECT PLANNING MILESTONES

PROJECT _____

	MILESTONE	DATE REQUIRED	DATE COMPLETED
1.	Designate Crew Leader and Planning Team		
2.	Pre-Planning Conference		
3.	Review Plans and Specifications		
4.	Identify Long Lead Materials		
5.	Identify Required Skills and Training		
6.	Complete Project Scope Sheet		
7.	Complete Master Activity Listing		
8.	Develop Level II Network		
9.	Generate Construction Activity Listing		
10.	Develop Independent Material Take-Off		
11.	Develop BM/MTO Discrepancy List		
12.	Calculate Man-days and Durations		
13.	Complete Construction Activity Summary Sheets		
14.	Develop Level III Network		
15.	Input Network into Computer		
16.	Resource Level Project		
17.	Complete Master Activity Summary Sheets		
18.	Develop Level II Barchart		
19.	Consolidate Tool Requirements		
20.	Consolidate Equipment Requirements		
21.	Consolidate Safety Plan		
22.	Consolidate Quality Control Plan		
23.	Prepare Project Briefing		

Figure 2-5.—Project planning milestones.

REDICHECK Plan and Specification Review

1. Preliminary Review
   a) Quickly make an overview of all sheets spending no more than one minute/sheet to become familiar with the project.

2. Specification Check
   a) Check spec for bid items. Are they coordinated with the drawings?
   b) Check spec for phasing of construction. Are phases clear?
   c) Compare architectural finish schedule to specification index. Ensure all finish materials are specified.
   d) Check major items of equipment and verify they are coordinated with contract drawings. Pay particular attention to horsepower ratings and voltage requirements.
   e) Verify that items specified "as indicated" or "where indicated" are in fact indicated on contract drawings.
   f) Verify that cross referenced specifications sections exist.
   g) Try not to indicate thickness of materials or quantities of materials in the specifications.

3. Plan Check Structural
   a) Verify property line dimensions on site plan against architectural.
   b) Verify building is located behind set back lines.
   c) Verify column lines on structural and architectural.
   d) Verify all column locations are same on structural and architectural.
   e) Verify perimeter slab on structural matches architectural.
   f) Verify all depressed or raised slabs are indicated.
   g) Verify slab elevations.
   h) Verify all foundation piers are identified.
   i) Verify all foundation beams are identified.
   j) Verfiy roof framing plan column lines and columns against foundation plan column lines and columns.
   k) Verify perimeter roof line against architectural roof plan.
   l) Verify all columns and beams are listed in column and beam schedules.
   m) Verify lengths of all columns in column schedule.
   n) Verify all sections are properly labeled.
   o) Verify all expansion joint locations against architectural.
   p) Verify dimensions.

4. Plan Check Architectural
   a) Verify all concrete columns and walls against structural.
   b) Verify on site plans that all existing and new work is clearly identified.
   c) Verify building elevations against floor plans. Check in particular roof lines, window and door openings, and expansion joints.
   d) Verify building sections against elevations and plans. Check roof lines, windows, and door locations.
   e) Verify wall sections against architectural building sections and structural.
   f) Verify masonry openings for windows and doors.
   g) Verify expansion joints through building.
   h) Verify partial floor plans against small scale floor plans.
   i) Verify reflected ceiling plan against architectural floor plan to ensure no variance with rooms. Check ceiling materials against finish schedule, check light fixture layout against electrical, check ceiling diffusers/registers against mechanical, check all soffits and locations of vents.
   j) Verify all room finish schedule information including room numbers, names of rooms, finishes and ceiling heights. Look for omissions, duplications and inconsistencies.
   k) Verify all door schedule information including sizes, types, labels, etc. Look for omissions, duplications and inconsistencies.
   l) Verify all rated walls.
   m) Verify all cabinets will fit.
   n) Verify dimensions.

5. Plan Check Mechanical and Plumbing
   a) Verify all new electrical, gas, water, sewer, etc. lines connect to existing.
   b) Verify all plumbing fixture locations against architectural. Verify all plumbing fixtures against fixture schedule/specs.
   c) Verify storm drain system against architectural roof plan. Verify size of all pipes and that all drains are connected. Verify wall chases are provided on architectural to conceal vertical piping.
   d) Verify sanitary drain system pipe sizes and that all fixtures are connected.
   e) Verify HVAC floor plans against structural.
   f) Verify sprinkler heads in all rooms.
   g) Verify that all sections are identical to architectural/structural.
   h) Verify that adequate ceiling height exists at worst case duct intersection.
   i) Verify all structural supports required for mechanical equipment are indicated on structural drawings.
   j) Verify dampers indicated at smoke and fire walls.
   k) Verify diffusers against architectural reflected ceiling plan.
   l) Verify all roof penetrations (ducts, fans, etc.) are indicated on roof plans.
   m) Verify all ductwork is sized.
   n) Verify all notes.
   o) Verify all A/C units, heaters, and exhaust fans against architectural roof plans and mechanical schedules.
   p) Verify all mechanical equipment will fit in spaces allocated.

6. Plan Check Electrical
   a) Verify all plans are identical to architectural.
   b) Verify all light fixtures against architectural reflected ceiling plan.
   c) Verify all major pieces of equipment have electrical connections.
   d) Verify location of all panel boards and that they are indicated on the electrical riser diagram.
   e) Verify all notes.
   f) Verify that there is sufficient space for all electrical panels.

7. Plan Check Kitchen/Dietary
   a) Verify equipment layout against architectural plans.
   b) Verify all equipment is connected to utility systems.

Figure 2-6.—Redicheck plan and specification review.

Is removal of existing debris/material specified?

Is the laydown area sufficient?

Are other forces (public works or contractors) working in the same area?

Are clearances required for access to secured spaces?

What types of permits are required?

Methods

Are methods specified more difficult/expensive than methods more common to Seabees?

Do you have necessary skills (special training, tech reps, subcontracts)?

POSSIBLE LONG LEAD ITEMS

1. Pre-Engineered Buildings
2. Marine Piles
3. Telephone Poles
4. Doors
5. Windows
6. Screens
7. Transformers
8. Circuit Breakers
9. Switch Stations
10. Fire Alarm Systems
11. Intrusion Alarm Systems
12. Air Conditioning Systems
13. Specialty Electrical Items
14. Partitions
15. Water Heaters
16. Timber (especially large sizes)
17. Lumber, Plywood (large orders)
18. Roof Systems
19. Pre-Fab Joists
20. Structural Steel Members
21. Louvers
22. Treated Wood Products
23. Specialty Coatings
24. Structural Pipe
25. Marine Hardware
26. Carpet
27. Rubber Fender Systems
28. Bolted Steel Tanks
29. Epoxy Mortars/Grouts
30. Galvanized Metal Products
31. Chain Link Fence Fabric
32. HVAC Components
33. Fire Protection Systems
34. Large Quantities/Odd Sizes of Pipe/Fittings
35. Fire Pumps
36. Control/Feedback Systems
37. Enunciator Panels
38. Power Panels
39. Explosion Proof Systems
40. Large Quantity or Specialty Cable
41. Cathodic Protection Systems
42. High Intensity Discharge Light Fixtures/Lamps
43. High Voltage Specialty Switchgear
44. Silver Solder
45. Cabinets (wood and metal)
46. Hardware/locks/cipher locks

Finish items such as decorative brick, clay tiles, unusual carpeting may require time to locate.

Large purchases of any item (over $10k or 25k depending on local purchase authority) require time to competitively bid.

Electrical items tend to be unique to each installation and require additional time.

Figure 2-7.—Possible long lead-time items.

What tools are in the central tool room (CTR) and what is available for rent from local vendors?

It is important that you identify long lead-time items as soon as possible. For realistic schedules, you must take into account anticipated material delivery dates. Figure 2-7 is a list of possible long lead-time items. Any special training requirements must be addressed to the chain of command as soon as possible. Special training requires scheduling additional training after home port has begun and requires much coordination.

ESTIMATING

The crew leader is responsible for ensuring all required resources are identified. The crew leader must estimate materials, tools, equipment, and labor required to complete each construction activity. All required resources are listed on the CAS sheets. The scheduled start and finish dates for each activity are taken from the level III barchart and shown on the CAS sheet. The resources are then tied to the schedule, and any action required to track or request resources can be monitored on the CAS sheet.

ACTIVITY LISTINGS

Before you go any further with detailed project planning, the project must be broken into smaller parts. Each part can then be estimated individually. The project will first be broken into between 8 and 10 master activities representing large, functional parts of the project. Each master activity will then be broken into between 5 and 10 construction activities.

Master Activities

The regiments usually assign master activities to the projects. The master activities can be broken into at least 5 construction activities. Most commonly, master activities number between 8 and 10. These activities identify functional parts of the facility and are often tied to a particular company or rating. It must be clear to all personnel involved in the planning process exactly what work is included in each master activity. That is the purpose of the master activity listing (fig. 2-8). By providing a good narrative

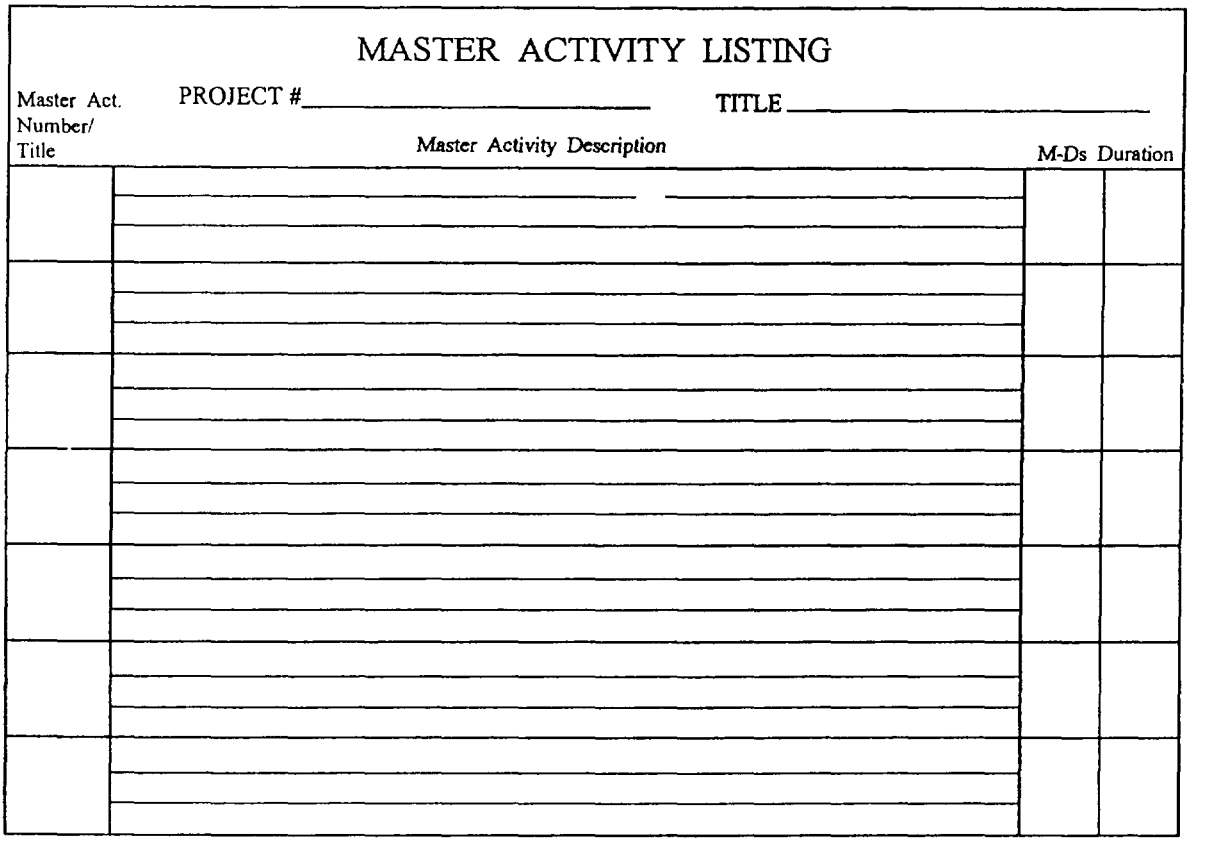


Figure 2-8.—Master activity listing.

description of each master activity, it will be clear to all where each work element falls. A good narrative description reduces the chance of omitting any work items from the estimate. Master activities for a typical building might look like the following:

10XX	Sitework
20XX	Underslab Utilities
30XX	Foundation and Slab
40XX	Walls
50XX	Roof
60XX	Rough Utilities
70XX	Interior Finish
80XX	Finish Utilities
90XX	Exterior Finish

Construction Activities

As the crew leader, you must break the master activities into construction activities. The work element checklist contained in appendix A to the NAVFAC P-405, *Seabee Planner's and Estimator's Handbook,* is a good guide for the development of the construction activity list. A typical Naval Mobile Construction Battalion (NMCB) project might contain between 15 and 50 construction activities. Construction activity numbers are usually four digits. The first two digits identify the master activity and the second two digits show a specific construction activity within a master activity. The number also includes a prefix assigned by Ops that identifies the specific project. Looking at the list of master activities example, this project could have a construction activity for "Pull Wire" numbered 6025. The number 60 represents master activity "Rough Utilities" and 25 distinguishes "Pull Wire" from other construction activities in that same master activity.

MAN-DAY ESTIMATES AND DURATIONS

You need to know how to calculate mandays and duration for each construction activity, The P-405 is the primary reference for Seabee man-day estimates. The P-405 lists how many man-hours it takes to do one unit of work, The size of the unit is also given. The quantity of work is divided by the unit size and multiplied by the man-hours required to do one unit. You then divide by 8 man-hours per man-day and multiply by a delay factor (DF). **Tasking, estimating, and reporting are always done in 8-hour man-days, regardless of the length of the workday.**

MDs = QTY of WORK ÷ UNIT SIZE x *MHRS PER UNIT* ÷ 8 x *DF*

For example, to install 16,000 SF of 1/2-inch drywall over wall studs would require how many man-days? (See page 4-78 of the P-405.)

MDs = 16,000 *SF* ÷ 1000 *SF* x 33 *MHRS* ÷ 8 = 66 x *DF*

Production Efficiency Factors

Production efficiency factors are the first step in adjusting man-day estimates based on your unique circumstances. The intent of a production efficiency factor is to adjust for factors that will make you more or less productive than the average Seabee. In calculating a production efficiency factor, consider only those factors that affect the crew **while on the job.** Table 2-1 has listed eight production elements in the far-left column. You need to consider the impact of each of these production elements on each activity given a specific crew, location, equipment condition, and such. You need to assign a production factor between 25 (low production) and 100 (high production) for each element. A production factor of 67 is considered average. Average these eight factors to figure your production efficiency factor (PEF).

Delay Factors

Before you can adjust the man-day estimate, you must convert the production efficiency factor to a delay factor. You can find the delay factor by dividing 67 (the average production factor) by the production efficiency factor (DF = 67/63.6 = 1.05). (See table 2-1.) Using the delay factor of 1.05 you now can adjust the original man-day estimate.

66 x 1.05 = 69.3 or 70 MD

This mathematical procedure has limitations. If for example you are working outside in extremely bad weather, and all other factors are considered average (weather = 25, all others = 67), you would obtain a production efficiency factor of 62 and a delay factor of 1.08. This 8 percent increase in the man-day estimate would not adequately compensate for working in extreme weather. You are not limited to the method of delay factors in the P-405. Use **common sense** when impacted by extreme circumstances.

PRODUCTION EFFICIENCY GUIDE FACTOR CHART

	LOW PRODUCTION 25 35 45	AVG PRODUCTION 55 65 75	HIGH PRODUCTION 85 95
1. WORKLOAD	CONSTRUCTION REQ'T HIGH, MISC. OVERHEAD HIGH	CONSTRUCTION REQ'T AVG, MISC. OVERHEAD AVG	CONSTRUCTION REQ'T LOW, MISC. OVERHEAD LOW
2. SITE AREA	CRAMPED WORK AREA, POOR LAYDOWN/ACCESS	WORK AREA LIMITED, AVG LAYDOWN/ACCESS	LARGE WORK AREA, GOOD LAYDOWN/ACCESS
3. LABOR	POORLY TRAINED/ MOTIVATED CREW	ADEQUATELY TRAINED/ MOTIVATED CREW	HIGHLY TRAINED/ MOTIVATED CREW
4. SUPERVISION	POORLY TRAINED/ MOTIVATED OR INEXPERIENCED	ADEQUATELY TRAINED/ MOTIVATED EXPERIENCED	HIGHLY TRAINED, MOTIVATED, AND EXPERIENCED
5. JOB CONDITION	HIGH-QUALITY WORK REQ'D, SHORT FUSE	AVG QUALITY WORK REQ'D, ADEQUATE TIME	ROUGH/UNFINISHED WORK REQ'D, WELL PLANNED
6. WEATHER	ABNORMAL HEAT, RAIN, OR COLD	MODERATE RAIN, HEAT, OR COLD	FAVORABLE RAIN, HEAT, OR COLD
7. EQUIPMENT	POOR COND., MAINT., REPAIR, OR APPLICATION	FAIR COND., MAINT., REPAIR, OR APPLICATION	GOOD COND., MAINT., REPAIR, OR APPLICATION
8. TACTICAL/ LOGISTICAL	SLOW SUPPLY, FREQUENT TACTICAL DELAYS	NORMAL SUPPLY, FEW TACTICAL DELAYS	GOOD SUPPLY, NO TACTICAL DELAYS

Let's calculate a production efficiency factor for our 16,000 SF of drywall. Let's say we are going to do this drywall work as part of a project to rehab the station CO's admin spaces. We must evaluate each production element from the table and assign a factor:

Production element:	Percentage	Remarks
Workload	67	No specific impact
Site Area	75	Good access, work area
Labor	35	Crew inexperienced, OJT required
Supervisor	75	Good supervisor
Job Condition	45	High quality work required
Weather	67	No impact
Equipment	70	Sufficient tools in adequate condition
Tactical/Logistical	75	Materials on-hand believed sufficient
	509	

$$PEF = 509/8 = 63.6$$

Come up with what you feel is a reasonable delay factor and discuss it with your chain of command. You are not bound by either the delay factors or the production rates in the P-405. To figure, man-day estimates, you can use your experience to determe the logical production rates to use. Keep in mind that the delay factor is only used to determine the man-day estimate for a particular construction activity. Each activity will have a different delay factor. All other calculations use the availability factor.

Availability Factors

Availability factors take into account that Seabees assigned as direct labor are not available 100 percent of the time. The 2nd/3rd Naval Construction Brigade provides the availability factors for planning purposes. Availability factors are sometimes still referred to as site efficiency factors. These factors vary between 0.75 for mainbody sites to 0.85 for detail sites. Using the following equation, you can determine the man-day capability (MC) for the main body and each detail.

$$MC = DL \times WD \times ME \times AF$$

Use DL to represent the number of direct labor assigned, WD for the number of available workdays, ME for the length of the workday divided by 8 (9/8 = 1.125), and AF is the availability factor. Multiply these four factors to figure the man-day capability. You can use this same equation to determine the direct labor manning for a detail if you substitute tasked man-days for MC and plug in AF, ME, and WD. The number of work days is taken from the deployment calendar.

Construction Activity Durations

The MC equation also can be used to determine construction activity durations. By substituting MD estimated for MC, plugging in crew size (CS) for direct labor assigned (DL), availability factor (AF), and man-day equivalent (ME), you can solve for the number of workdays required or project duration.

$$Duration = MD\ estimated \div CS \div AF \div ME$$

The activity duration is increased by including the availability factor to account for time lost from the project site. The actual crew you would expect to see on the jobsite on the average day would be the assigned crew multiplied by the availability factor. Always use the availability factor.

If in the drywall example you had a crew of 12 assigned, how long would it take to complete this task (availability factor 0.75, man-day equivalent 1.125)? Remember to use the revised man-day estimate. which includes the delay factor.

Using the formula:

$$Duration = 70 \div 12 \div 0.75 \div 1.125 = 6.91 \text{ or } 7.$$

CONSTRUCTION ACTIVITY SUMMARY (CAS) SHEETS

Once the master activities have been broken into construction activities, you will need to use a CAS sheet (figs. 2-9 and 2-10) for each activity. In addition to the activity description and scheduled dates, all the required resources are shown on the front. Safety and QC requirements are on the back. The space at the bottom of the back page should be used for man-day and duration calculations.

The CAS sheets should be able to stand alone. The CAS sheets should contain all of your notes, information, and calculations pertaining to man-days, durations, tools, and equipment. This way, if you are not available, someone else can use this information and the project can continue. It is very important that CAS sheets be filled out correctly. Almost all of your remaining planning is driven from the CAS sheets. Always use a pencil to fill them out, because they change constantly.

CONSTRUCTION SCHEDULING

You must put together realistic, workable schedules during your project's planning and estimating stages if you hope to finish the tasking on schedule during the deployment. Crucial to a workable schedule is the proper, logical sequence of activities and good realistic durations. Performing the forward and backward pass will identify the critical path. The critical path gives you a list of milestones (activity completion dates) that must be met. If these milestones are met, the project will be on track and finished by the scheduled completion date.

LEVEL II ROUGHS

As the construction schedule unfolds, a commitment of resources (labor and equipment) from

CONSTRUCTION ACTIVITY SUMMARY SHEET

PROJECT TITLE: _____

B. M. CODE: _____ PREPARED BY: _____ CHECKED BY: _____

START SCHEDULED: _____ FINISH SCHEDULE: _____

ACTUAL: _____ ACTUAL:

ACT. NO. _____ GROUP CODE _____

ACT. TITLE: _____

DESCRIPTION OF WORK METHOD: _____

DURATION: ESTIMATED _____ MAN-DAYS: ESTIMATED _____

ACTUAL _____ ACTUAL _____

Production Efficiency Factor: _____ RESULTING DELAY FACTOR: _____

LABOR RESOURCES:

NO.	DESCRIPTION	QTY.	NO.	DESCRIPTION	QTY.

EQUIPMENT RESOURCES:

NO.	DESCRIPTION	QTY.	NO.	DESCRIPTION	QTY.

MATERIAL RESOURCES:

NO.	DESCRIPTION	QTY.	NO.	DESCRIPTION	QTY.

ASSUMPTIONS: _____

Figure 2-9.—Construction activity summary sheet (front).

ACTIVITY NUMBER: _____ ACTIVITY DESCRIPTION: _____

SAFETY HAZARD	SPEC. REF.	REQUIRED ACTION

QUALITY CONTROL REQUIREMENT	SPEC. REF.	REMARKS/RESULTS

ENVIRONMENTAL HAZARDS	SPEC. REF.	ACTION REQUIRED

CONSTRUCTION COMMENTS:

Figure 2-10.—Construction activity summary sheet (back).

several different companies is required to ensure that you can maintain the schedule. Rough level II schedules coordinate the planning effort between companies and ensure that no particular company or rating is overtasked during any phase of the deployment. Good coordination in the beginning is less painful than a major overhaul later. Having determined the sequence and approximate duration of each master activity, you can construct a level II barchart. Each project will have a level II. The 0ps officers and the company commanders typically track projects using a level II. Barcharts will be covered in greater detail later in this chapter.

LOGIC NETWORK

The logic network is the basic management tool for control, monitoring, and distribution of all resources that are directly related to time. The logic network at the planning stage is a pure dependency diagram. All activities are drawn in the order in which they must be accomplished, without regard to particular construction preference. One of the major uses of the logic network during the planning stage is to indicate all activities that must be accomplished to complete a particular project (fig. 2-11). The individual network activities should be well-defined elements of work within the project and should be normally limited to a single rating. As a general rule, an activity should be created for any function that consumes or uses direct labor resources. Resources (manpower, equipment, tools, or materials) MUST be tied directly to the CAS sheet and network.

The crew leader constructs a logic network showing the sequence of construction activities from the first to the last and the dependencies between activities. It is important to do the logic network when breaking the project down into construction activities to ensure no items of work are left out. You do not yet have construction activity durations, so you are only concerned about the sequence of work. Each construction activity is represented by an activity block. in the network shown in figure 2-11, activities 1020 and 1030 cannot start until activity 1010 is finished. Activity 1040 cannot start until 1020 is finished, and activity 1050 cannot start until 1030 and 1040 are finished.

THE BASIC SCHEDULE (FORWARD AND BACKWARD PASS)

Using the crew sizes, you can now determine construction activity durations. Go back to the logic diagram and insert the durations to determine the basic schedule. Practice with the example here and those included later. Some minor revisions may be required to the basic schedule (see resource leveling) prior to setting the final schedule. On the precedence network you will need to insert into an activity block the activity number, description, and duration for each activity. A typical block is shown in figure 2-12.

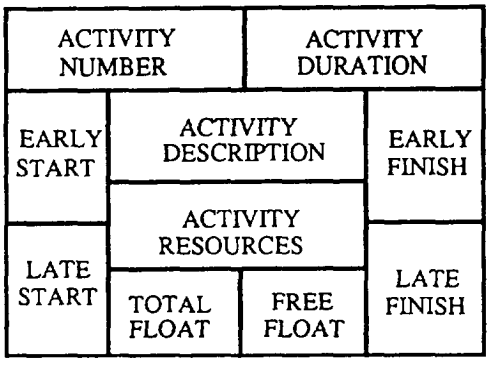


Figure 2-12.—Typical activity block.

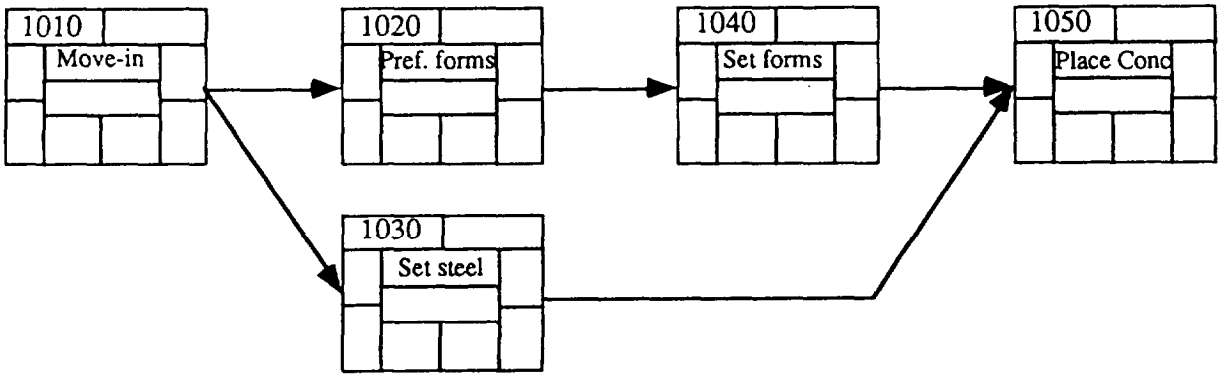


Figure 2-11.—Logic network.

The first step in determining the basic schedule is to do a **forward pass.** The forward pass gives you the total duration of your project. You start with the very first activity and plug in a zero for its early start date. Then add the duration to the early start date to get the early finish date. The early finish date for an activity becomes the early start date for the next activity. Notice that activity 1050 in figure 2-13 had two preceding activities (1020 and 1040) and you chose the larger of the early finish dates (11 vice 10). Remember to add any lag between the activities (between activity 1070 and the next activity there are 3 days lag time). **Lag times are mandatory wait times between activities.** A common example is concrete cure times. Cure times require you to wait several days to several weeks after placing concrete before you strip the forms. Follow the following two equations through the network in figure 2-13:

Early Start + Duration = Early Finish

*Early Finish + Lag (if any) = Early Start (next activity) **

Look at the network in figure 2-13, the early start and finish dates for an activity depend on the number and duration of the activities that have to be done before it.

The next step in determining the basic schedule is a **backward pass.** The backward pass determines your critical path. You start by taking the early finish date for the last activity and making it the late finish for the last activity. For each activity, subtracting the duration from the late finish date will give you the late start date. The late start date will become the late finish date for the preceding activity. Notice that activity 1040 in figure 2-13 has two follow-on activities and you took the smaller of the late starts (11 vice 12). Follow the equations shown through the network in figure 2-13. For any activity where the early start is the same as the late start and the early finish is the same as the late finish, that activity is critical!

Late Finish – Duration = Late Start

*Late Start – Lag (if any) = Late Finish (preceding activity)**

TOTAL FLOAT

Total float is the number of days an activity can be delayed without delaying the project completion date. Looking at activity 1020 in figure 2-13 you see that it could finish as early as day 10 or as late as day 12. The 2 days of leeway between day 10 and day 12 in activity 1020 are called total float. To calculate total float you subtract the early finish date from the late

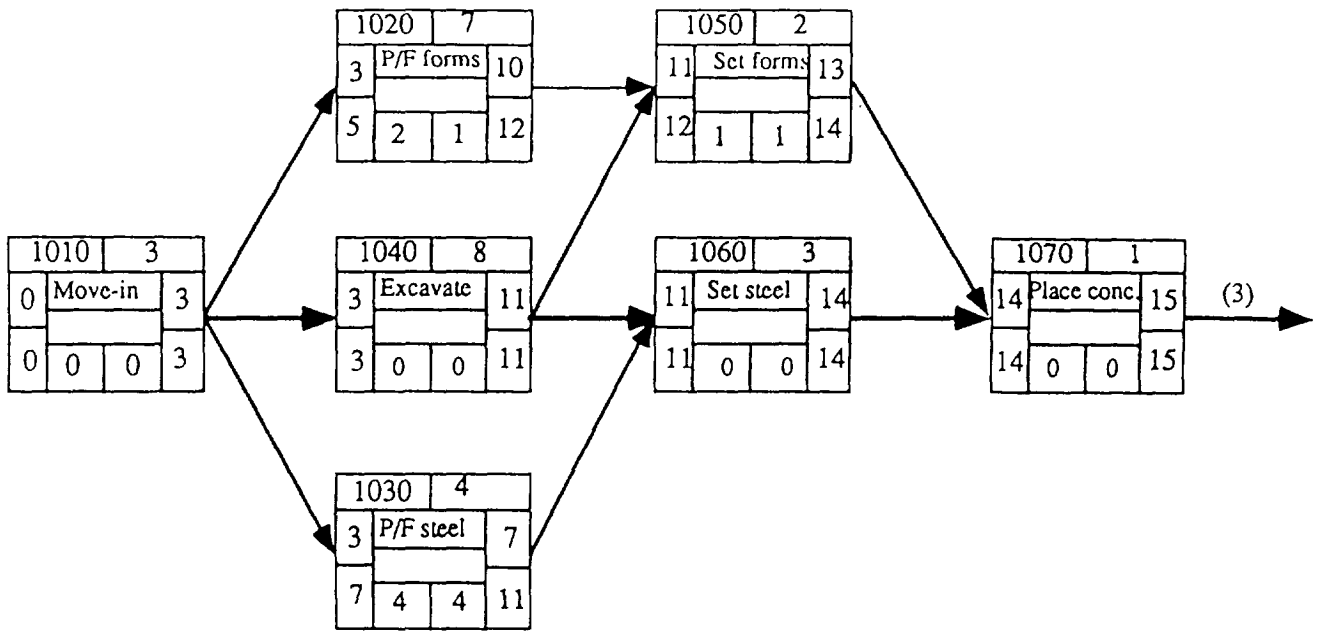


Figure 2-13.—Typical network.

finish date or the early start date from the late start date. The numbers will be the same. If not, you made a math error.

Total Float = Late Start – Early Start
(or Late Finish - Early Finish)

FREE FLOAT

Free float is the number of days an activity can be delayed without taking float away from the next activity. Another way of saying the same thing is that free float is the number of days an activity can be delayed without delaying the early start date of the next activity. To calculate the free float for an activity, you subtract any lag and the early finish for the activity from the early start for the next activity. To calculate the free float for activity 1020 in figure 2-13 you would take the early start for activity 1050, subtract any lag between 1020 and 1050 (zero in this case), and subtract the early finish for activity 1020 (11 - 0 - 10= 1). Free float for activity 1020 is 1 day. You can see that delaying activity 1020 by 1 day will not delay activity 1050 from its early start date. Delaying activity 1020 by 2 days will delay the start of activity 1050 until day 12 and will reduce the float for activity 1050 by 1 day (to zero, in this case). Delaying activity 1020 by more than 2 days will delay the project completion date because 1020 has only 2 days of total float.

*Free Float = Early Start (next activity) – Lag (if any) – Early Finish**

CRITICAL PATH

Looking at activity 1020 in figure 2-13 you see you could start that activity as early as day 3 or as late as day 5. Now subtract 3 from 5 and enter 2 days as the total float. Where the early start and late start are the same there is no float. No float means you have to start that activity on its early start date. It cannot be delayed without delaying the project completion. Activities with no float are said to be critical. The first and last activities will always be **critical** and there will be a **critical path** of activities between them. The critical path in figure 2-13 is 1010-1040-1060-1070. The critical path allows management to focus attention on those activities that cannot slip.

DIFFERENT LOGIC TYPES

All examples shown so far have used finish-to-start logic. This logic type requires an activity to finish before the next one can start. There are two other types of logic relationships that are frequently encountered. They are the start-to-start (S/S) and finish-to-finish (F/F). S/S is where the start of the second activity is dependent on the start of the first activity. F/F is where the finish of the second activity is dependent on the finish of the first activity. **Finish-to-start logic will give you the longest total project duration and is the most common logic type used in the NCF.** The S/S and F/F logic can be used to compress (shorten) the schedule. This compression is often used in the execution phase of the project to catch up. These logic relationships also can be used to plan repetitive work such as roadways or sewer lines. For a sewer line you wouldn't want to excavate the entire ditch before starting to lay pipe.

NOTE: Equations marked with an (*) are changed with different types of logic (S/S or F/F).

Start-to-Start

Forward Pass: Early start + Lag = Early start (next activity)

Backward Pass: Late start – Lag = Late start (preceding activity)

Free Float: Early start (next activity) – Lag – Early start

Finish-to-Finish

Forward Pass: Early finish + Lag = Early finish (next activity)

Backwwd Pass: Late finish – Lag = Late finish (preceding activity)

Free Float: Early finish (next activity) – Lag – Early finish

The general rule to follow with different types of logic is to **always follow your logic connectors.**

Figure 2-14 is an example of a network with lag times (between activities B and F, C and D, C and E). Figure 2-15 is an example of logic relationships. Using the formulas, work through the calculations.

LEVEL III BARCHARTS

Having determined the construction schedule on the precedence network, you must now transfer that

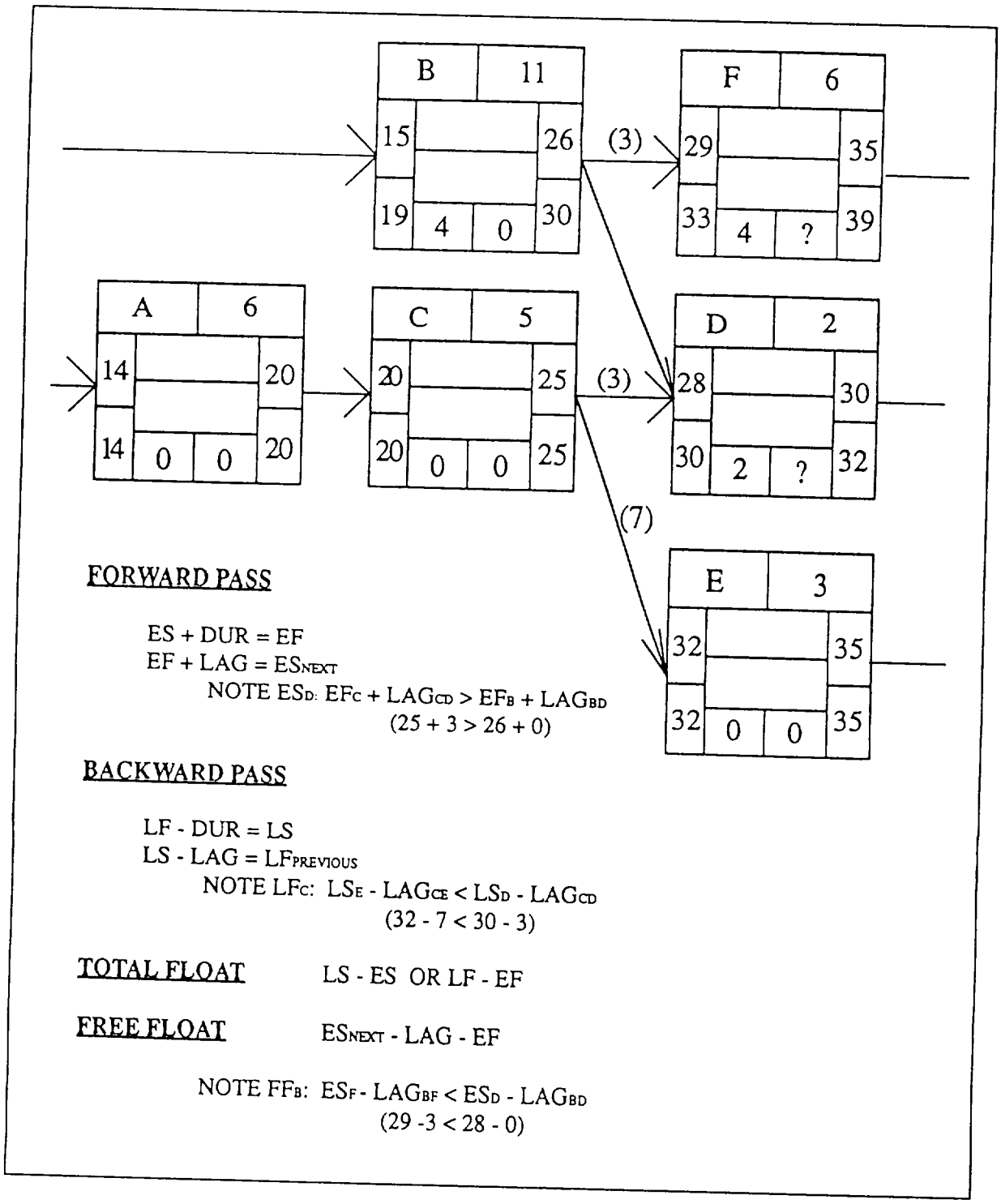


Figure 2-14.—Network calculation.

information to a barchart. Scheduled dates are much easier to read on a barchart. Figure 2-16 is a level III barchart sorted by early start date. All of the construction activities are listed down the left-hand side. A time scale is at the top of the page. The time scale goes from the first workday of the project to the last workday. The start date, finish date, and duration of each construction activity is shown on the barchart. The double horizontal dash lines represent critical construction activity durations. The single dash lines represent noncritical activity durations. Free floats are shown as dots behind each noncritical activity. For activities with no free float you have to look at the activity that they are sharing floats with to find the total float. For example, the total float for activity 4000 is shown behind activity 4005. No free float on 4000 means you cannot delay it without delaying 4005 also.

RESOURCE LEVELING

Resource leveling involves matching the construction activities scheduled to the crew size available. You want the entire crew to be gainfully employed every day. You also want to keep up with the scheduled work and not fall behind. To perform resource leveling, you need a known crew size, a time-scaled schedule, and a histogram. The histogram shows how many people in each rating are required on a daily basis to complete the tasks scheduled. You can create these documents by hand or computer. Figure 2-16 represents only the first page of a level III barchart. Look at figure 2-16 and you see can the resource histogram at the bottom of the page. The numbers give the required resources needed to complete the critical activities scheduled for each day. These activities cannot be moved without delaying the project!

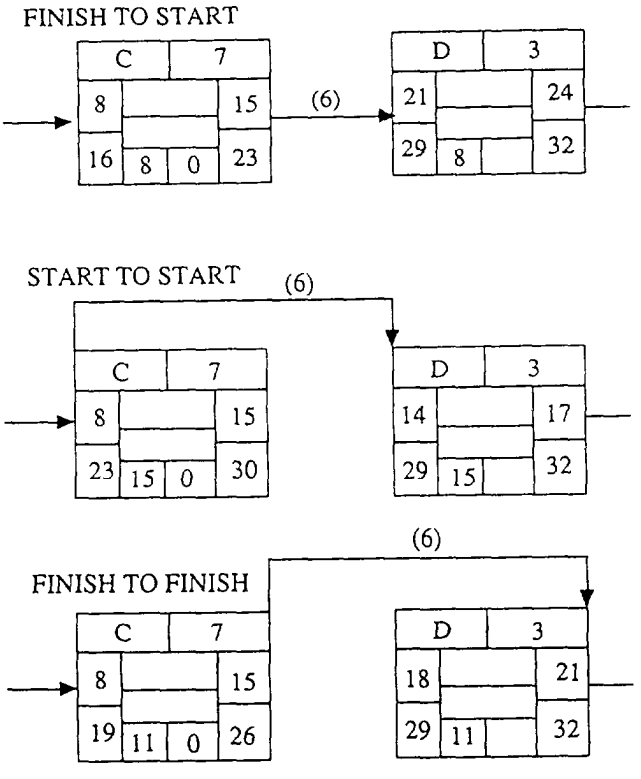


Figure 2-15.—Logic relationships.

The primary task in resource leveling is to schedule the noncritical work as you have people to do the work. In figure 2-17 the total float for noncritical activities has been penciled-in in the space between the activity numbers and descriptions. The crew sizes for each noncritical activity also have been penciled-in next to the activity start date. The total crew size in this example is 7. You have resource leveled this project for a small detachment scenario. Here the prime/sub arrangement is not practical and extensive cross-rate use of personnel is common.

In figure 2-18 notice the resource leveling process was started by committing to doing the critical path as shown and plugging in the resources. These resources can be figured by the computer or drawn in manually at the bottom of the page. The critical path will obviously not keep the entire crew busy (see the original total resource numbers at the bottom of the page). The noncritical activities are shown on their early start dates, but you may need to delay the start dates if you lack the people to start the noncritical activities at that time. If you delay the start of a noncritical activity, you want to schedule its start as soon as you have people (available those days where total resources are less than 7).

Figure 2-18 has been resource leveled. The activities were scheduled beginning with the least amount of total float to those with the most total float. Activity 2050 was scheduled first, then 2090, 3020, 3010, 4000, 4005, 4030, and 4010. This process should be continued through the rest of the project. Notice that there were not yet any personnel to schedule for activities 2010, 2020, 2030, 7010, or 7020. These resources would be carried over to the next page of the barchart. We also did not schedule activities 6020, 8080, 9010, or 8095. Even though they have the least amounts of total float, these activities have early starts late in the project and can be rescheduled later. Remember the activities are shown by early start dates and can be moved forward only,

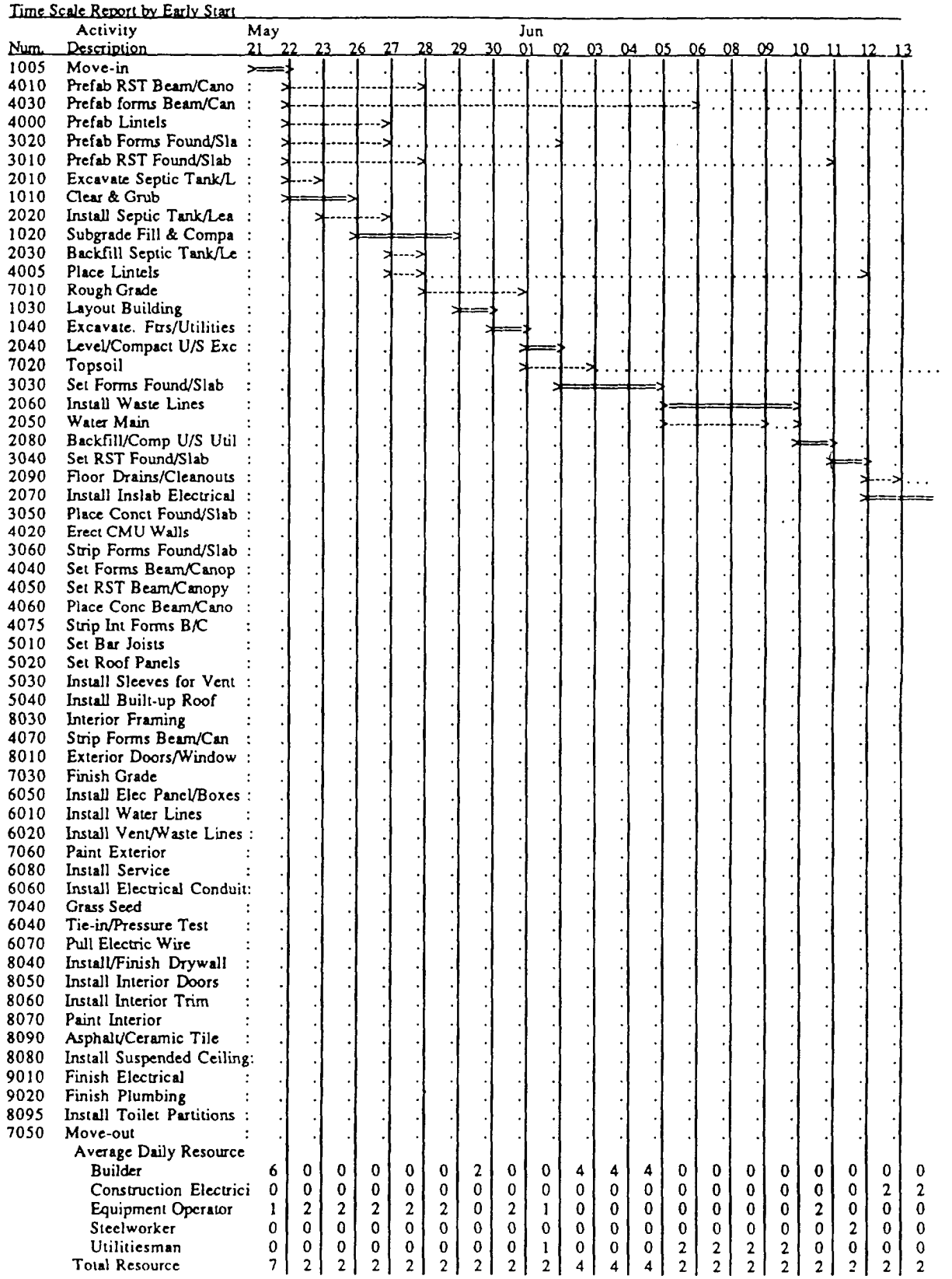


Figure 2-16.—Level III barchart sorted by early start date.

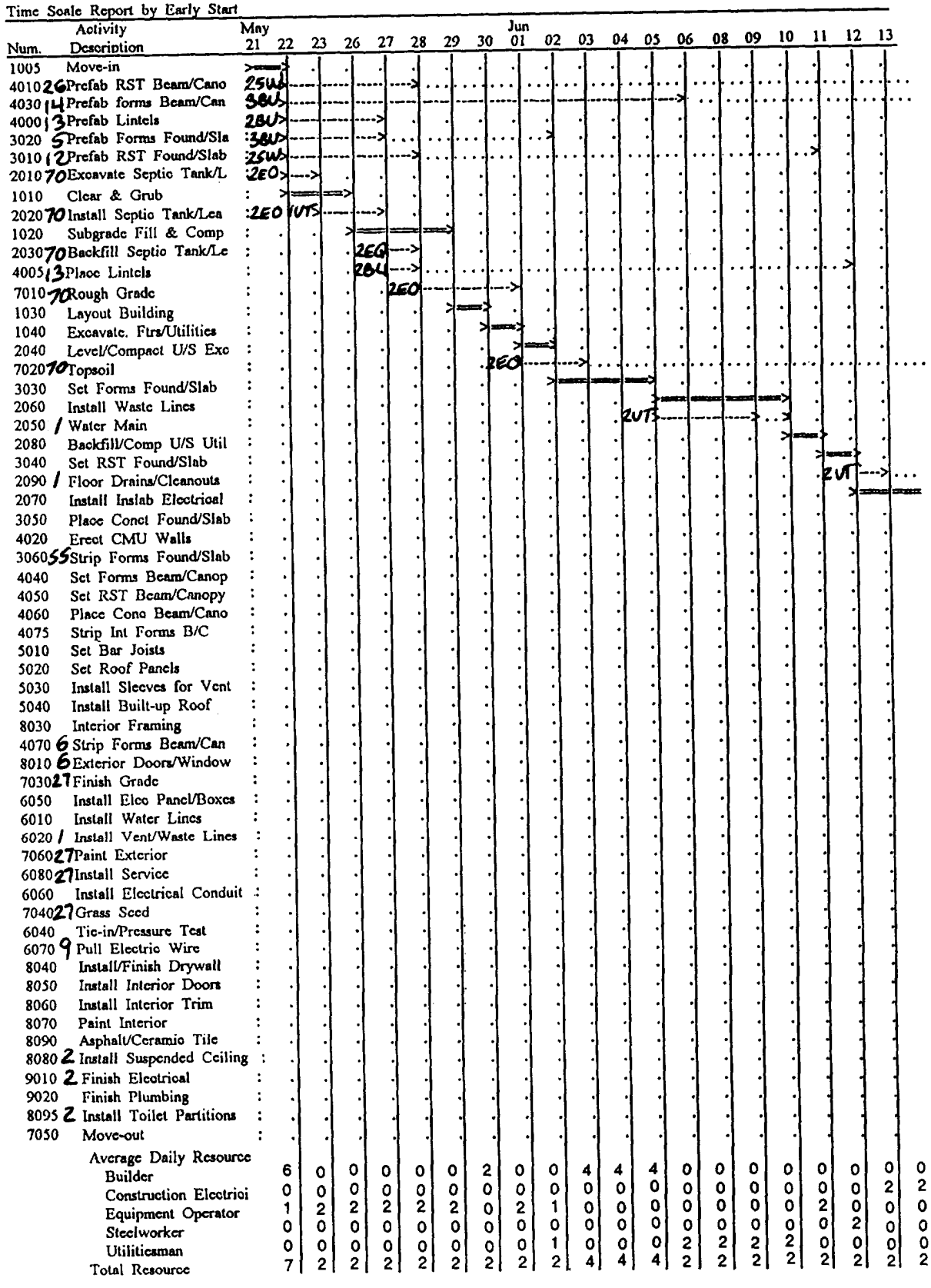


Figure 2-17.—Level III barchart with total float and crew sizes penciled-in.

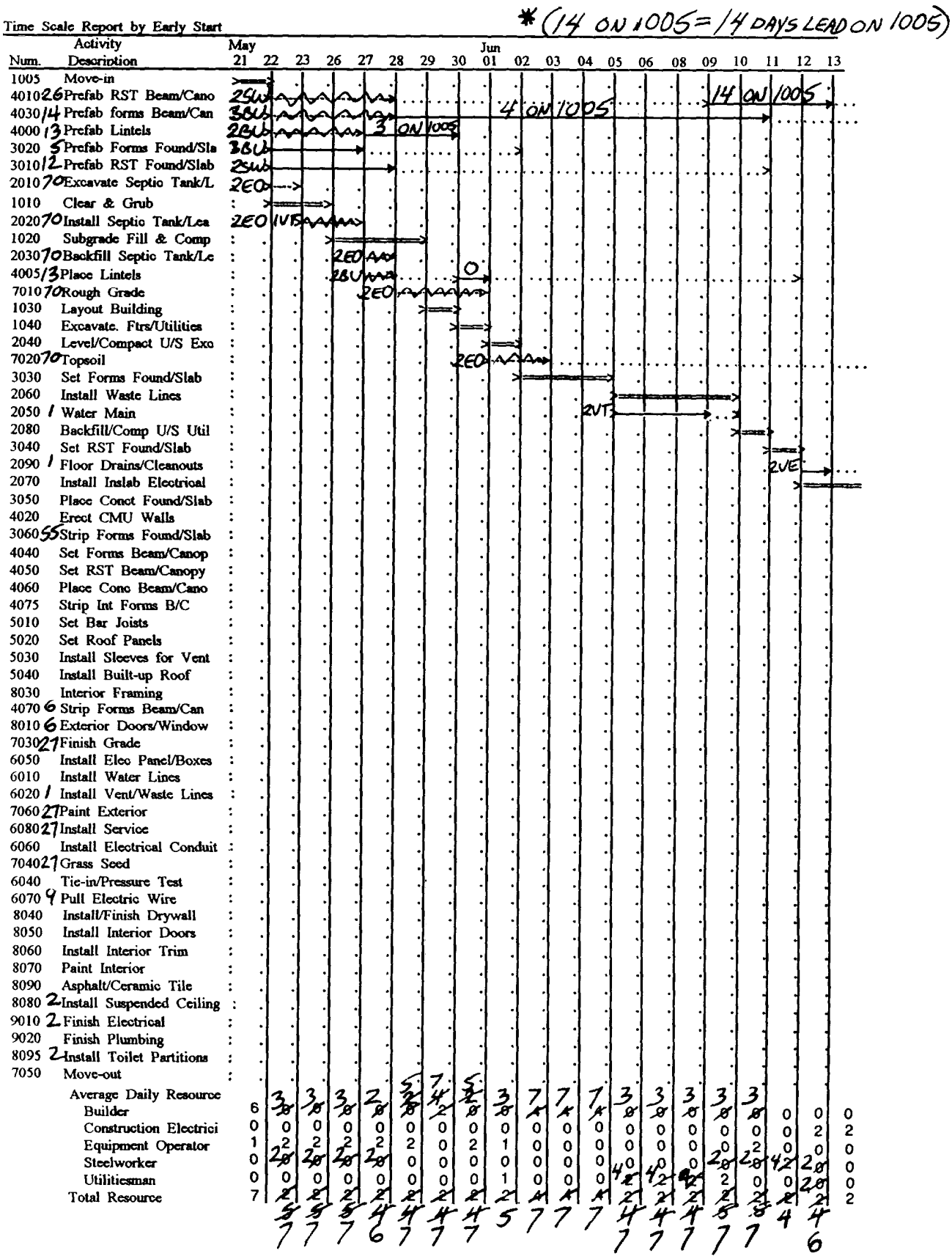


Figure 2-18.—Resource leveled level III barchart.

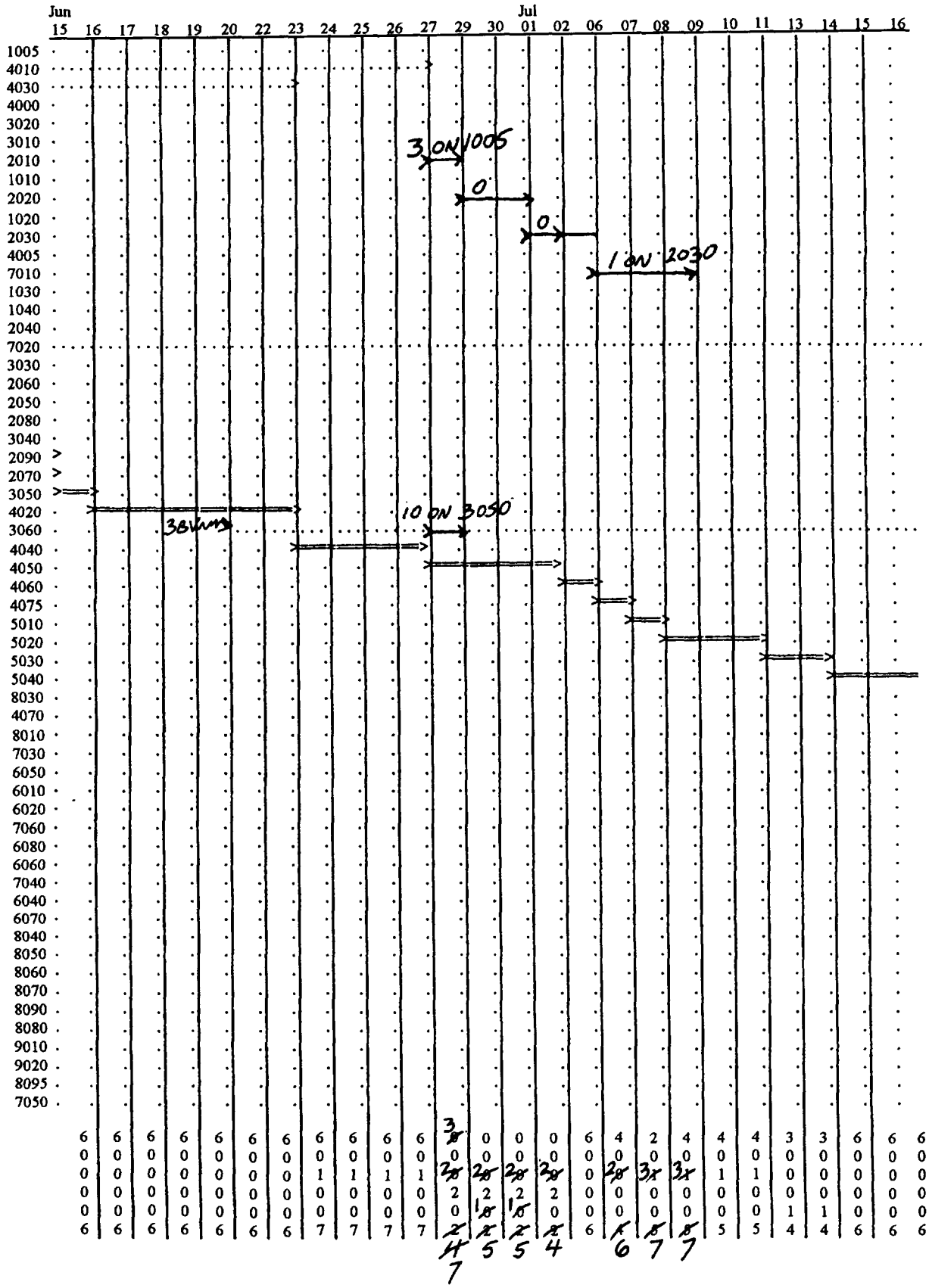


Figure 2-18.—Resource leveled level III barchart—Continued.

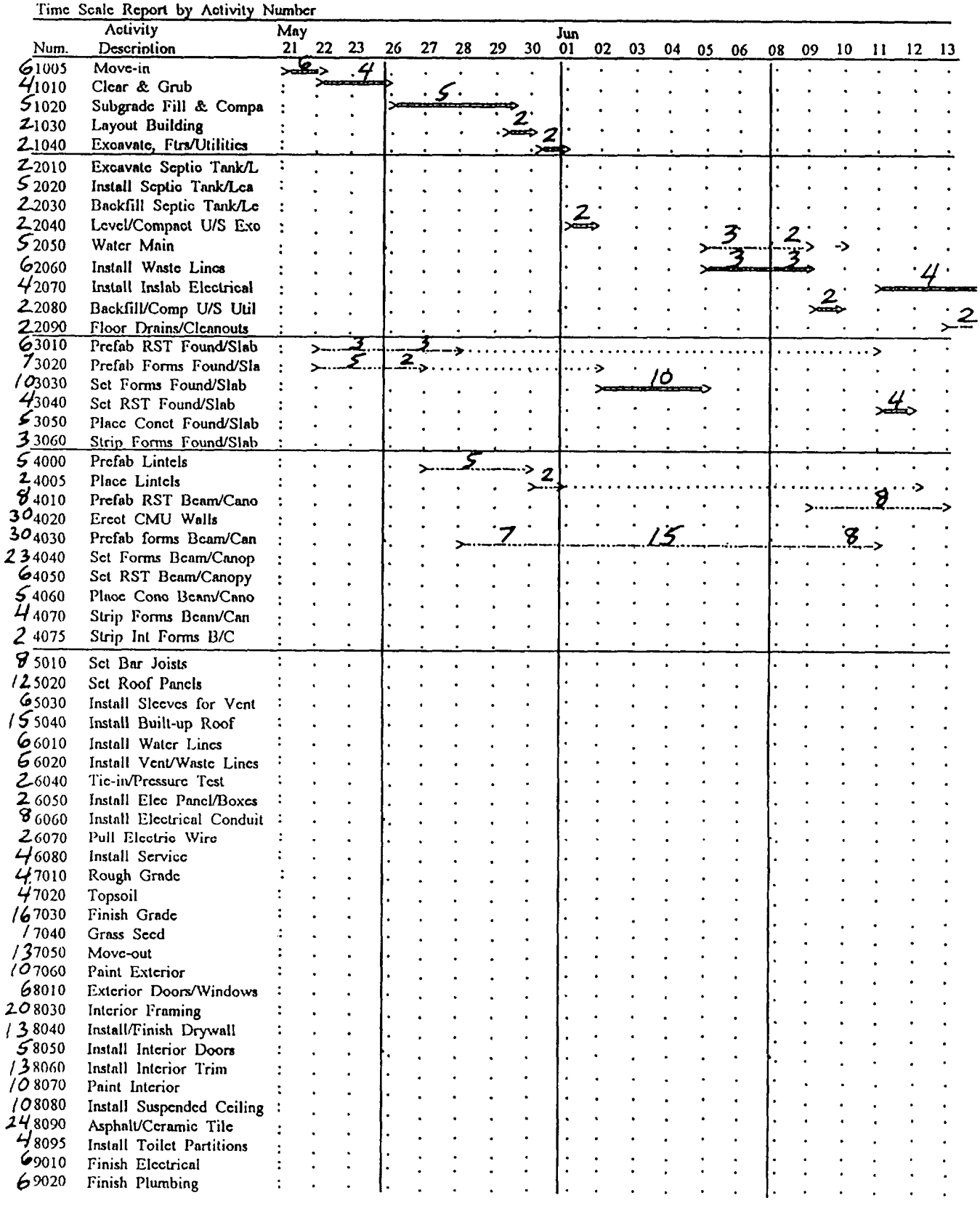


Figure 2-19.—Level III barchart sorted by activity number.

never backward. Also remember that activities that show no free float are tied by dependency to other activities. If one moves the others must move. Such is the case of activities 4000 and 4005.

Some minor adjustments on crew sizes and durations may be required to ensure full use of assigned crew. Once all the activities are scheduled, you can input the noncritical resources and delayed start dates (using lags) and create a new barchart. You can create this new barchart with the computer or manually.

LEVEL II BARCHART

You make a level II barchart from the information gained from the level III. Figure 2-19 is a level III barchart with construction activities sorted by activity number. This sorting allows for an easy transfer of information to the level II. Vertical lines on the level III separate the weeks and horizontal lines separate the master activities. The man-day estimate has been taken off the CAS sheets and penciled-in to the left of each activity number. The man-days have also been written over each line representing the activity duration. Where an activity was split between 2 weeks the man-days were prorated between the 2 weeks. Master activity 10 has a total man-day estimate of 19 (the sum of the construction activity estimates). You can now transfer the information to a level II barchart.

Figure 2-20 is a level II barchart. The master activities are listed in a column on the left and the weeks of the entire deployment across the top. The dates used are always the Monday of that week. Next to each master activity is the man-day estimate for that master activity. The next column is the weighted percent, which is the master activity man-day estimate divided by the total project man-day estimate

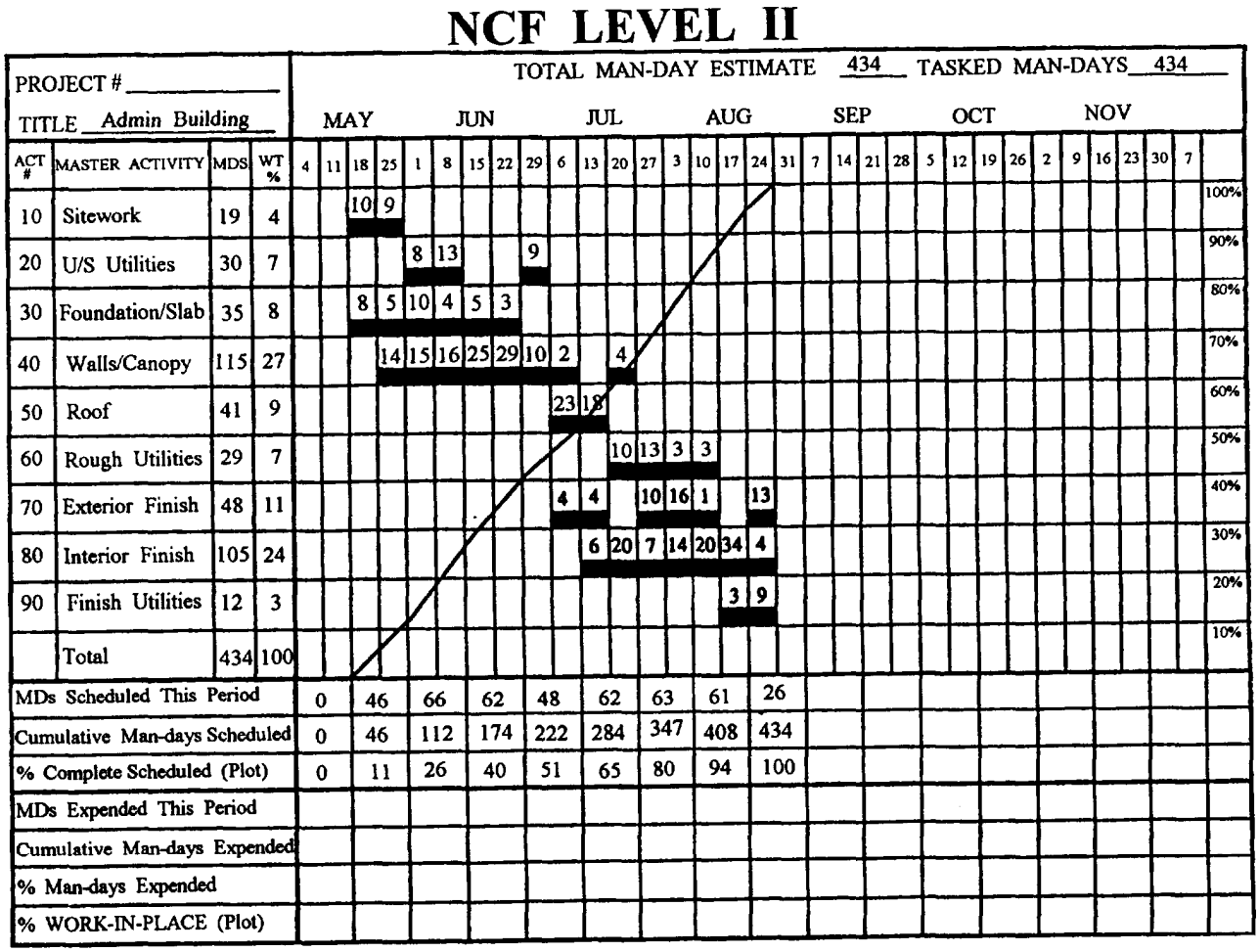


Figure 2-20.—NCF level II barchart.

expressed as a percent (multiplied by 100). If you look back at the level III barchart, you will see that master activity 10 has 10 man-days scheduled during the week beginning 18 May, and 9 man-days scheduled during the week beginning 25 May. Figure 2-20 has a horizontal bar connecting the weeks of 18 and 25 May for master activity 10 (sitework). The scheduled man-days for activity 10 are printed above the bar.

Once you have all the bars signifying master activity durations and the man-days scheduled on the barchart, you total the man-days scheduled for each 2-week period at the bottom of each column. The cumulative man-days scheduled is equal to the man-days scheduled for each 2-week period added to all previous man-days scheduled. The percent complete scheduled (plot) is equal to the cumulative man-days scheduled divided by the total project man-days. The scheduled progress curve is then drawn by plotting the percent complete scheduled at the end of each 2-week period plotted against the percentage scale on the right of the level II barchart.

PROJECT EXECUTION

Satisfactory execution of construction tasking requires that various resources come together at a specific time and place. It is **not** just materials, equipment, and personnel. It is the **correct** materials, the **proper** equipment, and **capable** personnel. Your job of managing construction projects is made much simpler if you have already identified what you need to complete each activity. During the project planning stage, you identified the tools, equipment, materials, and personnel required for each part of the construction activity. This section of the chapter explains the various methods you can use to track these resource requirements from the home port planning phase to the day you begin work and eventually close out the project.

CAS SHEETS

Proper use of CAS sheets greatly reduces the chance of the construction effort being slowed or halted due to a lack of resources. The majority of the resource requirements identified on the CAS sheet require some further action on the part of the crew leader. Any action required can be tracked right on the CAS sheet. Highlight the required action whether it is a requisition to be submitted or an equipment request to be turned in. List the required action and the due date on the CAS sheet and circle it in yellow. Of particular significance are the local purchase materials. In general, no local purchase material is procured until requested by the crew leader. This request may be in the form of a 45-day material plan completed by the crew leader while in home port or a 1250-1 turned into MLO several weeks in advance. It is the crew leader who must initiate the local purchase action. Lead times for obtaining equipment and materials vary from several days for materials in the MLO yard to several weeks for equipment rented from a private contractor. If MLO needs a lead time of 2 weeks for a concrete request and you have a concrete placement scheduled for 30 September, make a note on the CAS sheet to turn in a 1250-1 by 16 September.

LEVEL III BARCHARTS

An accurate assessment of the project status must be maintained on the jobsite continuously. Even a single day's deviation from your schedule makes a big difference to the concrete supplier, the hired crane operator, and your subcontractors. This does not mean that your project has to be replanned every 2 weeks. Updated project status can be reflected on the posted level III barchart. The critical path should be highlighted in red. The daily status should be shown in yellow. Daily status will show where you stand on each activity in comparison to the schedule. Figure 2-21 demonstrates a technique for reflecting total project status on a biweekly basis. Two vertical lines are drawn on the barchart, one at the 15th and one at the 30th of each month. The line on the 15th is broken and the line on the 30th is solid. Depending on the date, the line shows at a glance which activities are ahead or behind. Refer to figure 2-21; notice that activities 101 and 102 were completed by the 15th. Also notice that activity 401 is 1 day ahead and activity 402 is 1 day behind. By the 30th all scheduled work will be completed.

TWO WEEK SCHEDULES

A successful crew leader must **manage** a project on three different planes. The crew leader must directly supervise the construction effort underway. The crew leader must also look at activities scheduled for the next 2 weeks to ensure an uninterrupted flow of resources to the project. And he/she must keep an eye on any long lead items. It is the long lead items that, if not tracked continuously, would be most likely

LEVEL III BARCHART

SHOWING BIWEEKLY PROJECT STATUS

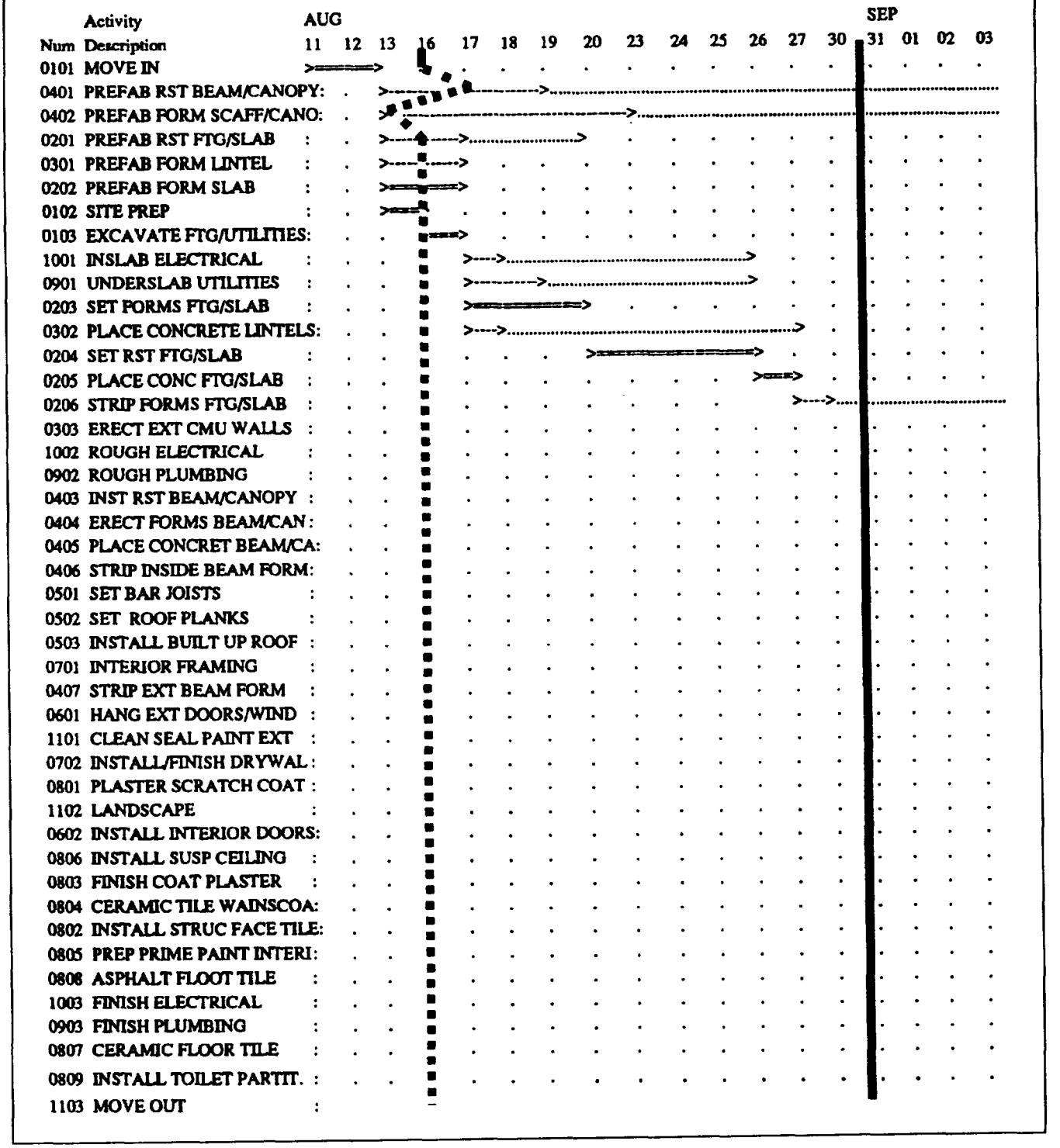


Figure 2-21.—Level III barchart showing biweekly project status.

to cause a work stoppage or delay. Figure 2-22 is a sample of a page from a 2-week schedule. The items of work listed on 2-week schedules must be clear and measurable. All 2-week schedules must show the work on the level III for that period. If you are behind schedule, the 2-week schedules must also reflect how you are going to get back on track. Key resource requirements for the activities scheduled for the next 2 weeks are listed on this schedule. This scheduling tool is used primarily by the crew leader to ensure that all materials required are either on the jobsite or have been requested with sufficient lead time to ensure availability. The 2-week schedules are used in crew briefings, to provide ongoing project status to the chain of command, and to give a heads up to MLO and the subcontractors. Two-week schedules are also referred to as weekly goals.

REQUESTING RESOURCES

Ensuring that the resources you need are available when you need them is much less painful when you adhere to the required lead times. If you need to better understand what MLO's turnaround times are, ask! The 1250-1s can be filled out and retained in the project packages weeks or even months in advance. Dropping off 1250-1s at MLO 3 days before you need the material (for material in the yard) is easier on you and on MLO. The short-fused, "I need it now" requests are tough on everyone. The crew leader should consider the 3 days a minimum required lead time for requesting material from MLO. MLO operates more effectively and cooperates more readily when they are not required to drop what they are doing to get your material. If everyone gave MLO more lead time, there would be better service to all project sites.

CREW BRIEFINGS

Crew briefings are a must! Obviously the crew needs to know what they are going to be doing and how they are going to get it done, but they need to know much more. They need to be aware of safety hazards and preventive measures (stand-up safety lectures). They need to know what the quality measures are (How smooth is smooth? How vertical is vertical?). And they need to know the schedule. Crews need to know how much time has been scheduled for the current activity and what the impact on the overall schedule will be if the current activity is delayed. Figure 2-23 is a prep list you can use to improve crew briefings.

TWO-WEEK SCHEDULE

PROJECT NUMBER _____ PROJECT TITLE _____ WEEK ENDING _____

Construction Activity		Goal	Material, Tools, and Equipment Required	Special Requirements	Remarks
Number	Description				

Figure 2-22.—Two-week schedule.

MASTER ACTIVITY PREP LIST

Project Number _____
Project Title _____
Activity Number _____
Activity Description _____
Early Start Date _____
Late Finish Date _____
Estimated Duration _____

Resource check to be completed by the crew leader prior to commencement of work:	(Y/N)
Have the construction methods been clearly described on the CAS sheets?	_____
Are all the materials estimated on the CAS sheets on site, stored properly and in compliance with the plans and specifications?	_____
Have required shop drawings been prepared?	_____
Has the equipment listed on the CAS sheets been reserved?	_____
Are the tools listed on the CAS sheets on site or being reserved?	_____
Is the safety equipment/personal protective gear listed on the CAS sheets on site or reserved?	_____
Briefing of crew to be completed by the crew leader prior to commencement of work:	**(✓)**
Discuss all required tests and inspections	_____
Establish levels of quality for each element of the work	_____
Discuss all other pertinent parts of the specifications	_____
Discuss each individual's job and establish specific measures of performance	_____
Define each crew member's responsibility and authority	_____
Clearly outline the sequence of work activities	_____
Discuss all safety requirements from the CAS sheets and instruct crew members in the proper use of safety equipment	_____
Stress the importance of good housekeeping	_____

Figure 2-23—Master activity prep list.

REGAINING THE SCHEDULE

Many unanticipated problems appear during the execution of your tasking. All of these problems will likely have at least some impact on the schedule. Finding yourself 1-2 percent or several days behind schedule is not a catastrophe. But you will need a plan to get back on track and regain the schedule. There are nearly limitless possibilities for solving the problems and regaining the schedule.

Better Methods

Often there are faster methods of construction than the ones you originally planned or are currently using. If you are behind, a quick scan of the CAS sheets' upcoming activities might reveal an opportunity to shave some man-days by changing methods. Better equipment frequently results in less time being expended. For an underground pipe job, renting a trencher would save many man-days over using the backhoe. Better methods and equipment are tied to the availability of project funds. Consult others in identifying man-day saving alternatives, and remember to "work smarter, not harder."

Increase Effective Workday

Obviously, by skipping quarters every morning you could get another 20 minutes of work out of your crew. But it is not likely your chain of command will find that to be an acceptable method of increasing the workday. Another way of getting more hours out of the same number of people is to increase your actual availability. Remember, for planning purposes you used a site specific factor that was somewhere between 0.75 and 0.85. You can calculate the actual availability factor for the project using the following formula:

$$AF = \frac{MD\ expended}{Crew\ assigned \times WD \times MDE}$$

To determine an actual availability factor you need to know the size of the crew assigned, the man-days they expended over a certain period, and the number of workdays in that period. If the actual availability is low (below 0.75), you may want to consider permanent changes to the daily crew routine (haircuts, paychecks, liberty, gedunk runs, and such) to increase availability. Even if your availability is average you can increase it for a short time to get back on schedule. Work with your chain of command to coordinate dental appointments, disbursing problems, page twos and other things that take crew members away from the jobsite. Increasing availability by 10 percent has the same effect as adding another member to your crew.

Phasing of Activities

Projects are usually laid out initially on a logic diagram using nearly all finish-to-start logic relationships. This has the effect of stretching project duration and reducing required crew size. It also leaves plenty of opportunity to compress the schedule by working several activities at the same time. You may be able to squeeze a few days out of your schedule by splitting your crew and having some of them work on the next activity. To make any real gains on your schedule you will probably need additional people. If you present your chain of command with a plan designed to get back on track, you could get those additional crew members temporarily.

MEETING THE SCHEDULED PROJECT COMPLETION DATE

After the 45-day review, project schedules are firm. The battalion is committed to meeting the scheduled project completion dates. As soon as the crew leader feels the completion date is no longer within reach, the chain of command must be informed. If the company staff cannot get the project on schedule, the Ops officer should be informed. The customers are counting on getting the facilities delivered on the scheduled date, and delays may have a big impact on their plans. Delays may also impact on the schedules of the follow-on battalion.

EFFECTIVE MANPOWER UTILIZATION

In maintaining project schedules, crew leaders must make effective use of personnel assigned to them. An established policy for mid-watch sleep-ins and a means for getting them to the job at the correct time must be coordinated. Many of the paper work problems can be handled by the company staff/chain of command. Use them to help your crew members get their problems solved and minimize time lost. People are either involved in productive work or they are not. It is the crew leader's responsibility to keep the crew productively employed. To maximize productive output, the crew leader must remove obstacles to productive work. Look at some potential time-wasters and consider how you could best increase the productive output of the crew.

Getting to the Jobsite

After morning quarters, crews should be able to get on a crew truck and depart for the project site with no further delay. Crews should not return to the barracks or the galley after quarters. Any tools or materials to be used up that morning should be drawn and loaded on to the crew truck before quarters. Turning in 1250-1s for materials and tools several days in advance will greatly reduce the time spent drawing them from MLO/CTR. Tools requiring safety checks should be dropped off the afternoon before and picked up in the morning. The hours of operation for MLO, CTR, and the other outlets should be addressed prior to deployment. It is very common to see MLO and CTR open an hour before quarters.

Breaks

The frequency and duration of breaks are determined by the crew leader based on how strenuous the work is, the temperature, and other climatic factors. The crew should understand the daily break routine. Watch for people anticipating breaks, standing around 5 minutes before the break is scheduled, or waiting for the crew leader to announce it. You want the crew working until they are told to break. This can be a particular problem near lunchtime and the end of the workday. Similarly, the crew must be back "swinging hammers" immediately after the break concludes.

Paydays

There are usually several options on locations and times for cashing paychecks. Find the shortest lines. Remember you are trying to minimize time lost. A common scenario is to knock off 2 hours early on paydays to get checks cashed and make an exchange run. If this tactic is used, be sure your crew does not abuse it.

Medical/Dental

Try to schedule appointments for routine treatment/examinations first thing in the morning or at the end of the workday. If several members of your crew need to be seen for dental recall, try to get them scheduled together. Getting a group back to the jobsite will be easier than getting them back separately. Coordinate a transportation plan with other crews working in the same general location to get crew members left in camp back out to the jobsite.

PROJECT MONITORING

The techniques used to evaluate the status of a project and compare the actual progress to the scheduled progress is referred to as **project monitoring.** To monitor a project's progress, crew leaders **must** master completing timecards, submitting SITREP input, figuring work in place (WIP), updating barcharts, and arranging project photos. This section of the chapter will explain the techniques used to monitor a construction project.

TIMECARDS

Timecards are the most accurate way to record man-days being expended on a construction project. Timecards allow you to monitor the efficiency and accountability of your crew. It is imperative that timecards be filled out correctly since they are the basis of your SITREP input. Timecards are also the basis for historical data on the project, availability factors, P-405 estimates, and such. Daily Labor Distribution, COMTHIRDNCB-GEN 5300/1, is the form used when recording man-days expended.

Crew Leaders

Crew leaders must prepare timecards each day that reflect man-days expended by all personnel assigned to them. Subcontractor crew leaders must use a timesheet (fig. 2-24) in lieu of the standard timecard. An additional copy of this timesheet can be made with a sheet of carbon paper, but in all other ways it is identical to the standard timecard. The sub crew leader must fill out the timesheet in duplicate while on the project. The timesheet reflects all subcontractor labor and is signed by both the prime and sub crew leaders. The prime keeps the copy and turns it in with the timecard for prime personnel. The sub turns in the original to the company timekeeper. This method allows the prime crew leader and the chain of command to monitor the effort being expended by the subs and the time being charged against the project. All labor should be recorded to the nearest half hour. Timecards must be maintained on file in the company office for the duration of the deployment.

Productive Labor

Productive labor is man-days expended that directly contribute to the accomplishment of the battalion mission. This includes construction

Project # _____ Date _____
Project Title _____
Prime Company_____
Sub Company_____

Prime/Sub Time Sheet

Sub Crew Assigned Rate/Name	Direct Labor Man-hours Expended by Master Activity											Indirect/Overhead/Other Man-hours Expended							
	10	20	30	40	50	60	70	80	90	100	Total								Total
Total																			

Prime Crew Leader Signature_____ Sub Crew Leader Signature_____

Figure 2-24.—Prime/sub timesheet.

operations, military operations and readiness, disaster recovery operations, and training.

Direct Labor

Direct labor includes all man-days expended directly on assigned construction activity, either in the field or in the shop. Direct labor also includes any labor that contributes directly to the completion of the project. Direct labor must be reported separately for each assigned master activity.

Indirect Labor

Indirect labor is man-days expended to support construction operations, but that does not produce an end product in itself. Equipment maintenance and production of shop drawings are examples of indirect labor.

Overhead Labor

Overhead labor is man-days expended that must be performed regardless of the assigned mission.

Military Operations and Readiness

Military operations and readiness are man-days expended in actual military operations and unit embarkation. Operations and readiness man-days also include any planning and preparation necessary to ensure unit military and mobility readiness.

Disaster Recovery Operations

Disaster recovery operations is man-days actually expended during disaster recovery operations.

Training

Training is man-days expended for service schools, factory and industrial training, fleet-type

training, military training, and organized training conducted within the battalion.

SITREP INPUT

The battalion sends to 2ndNCB/3rdNCB monthly SITREPs that report on the progress of construction tasking. The accuracy of the SITREPs is a reflection of how well the crew leaders have documented labor expended on the projects (timecards) and the quality of the input provided by the crew leaders and the companies. Figure 2-25 is an example of a SITREP feeder with information, calculations, and totals designed to help you create accurate reports.

Weighted Percent

The weighted percent for each master activity in figure 2-25 is simply the man-days estimated for that master activity divided by the total project man-days estimated. For master activity 60, rough utilities, the

SITREP FEEDER

Project Number_____
Project Title_____
Period Covered_____
% Complete Scheduled_____
Date_____

			a	b	a x b		
#	Master Activity Description	Original MD Est	Weighted Percent	Master Activity & Comp (WIP)	Project % Complete	Man-days Remaining	Man-days Expended
10	Sitework	19	.04	100	4.0	0	22
20	U/S Utilities	30	.07	80	5.6	6	23
30	Found/Slab	35	.08	57	4.6	14	27
40	Walls/Canopy	115	.27	0	0	115	0
50	Roof	41	.09	0	0	41	0
60	Rough Util	29	.07	0	0	29	0
70	Exterior Fin	48	.11	0	0	48	0
80	Interior Fin	105	.24	0	0	105	0
90	Finish Util	12	.03	0	0	12	0
TOTALS		434	1.00	X	14.2	370	72

Comments:

Figure 2-25.—SITREP feeder example.

man-day estimate was 29. When 29 is divided by 434 the answer is 0.07 weighted percent.

Master Activity Percent Complete (WIP)

Obviously, for master activities not started the WIP is zero percent and for completed master activities the WIP is 100 percent. For master activities that are partially complete, the crew leader must look at the status of the individual construction activities. Table 2-2 is expanded from figure 2-25 for master activity 30, foundation/slab.

In evaluating the progress on master activity 30 you can see that you have completed the prefab of the forms and the RST. These construction activities represent 17 and 20 percent of the master activity. For the set forms/RST activity you obtained the 50 percent complete by actual measurement. **Do not use man-days expended, for they have nothing to do with WIP.** In this case you measured and determined that one-half of the forms and RST have already been set. Set forms/RST represents 40 percent of the master activity, since you are half done you get credit for 20 percent. Add the 20 percent plus the previous 17 percent and 20 percent for a total of 57 percent completion for master activity 30.

Project Percent Complete

Project percent complete represents that portion of the work completed on the master activity that contributes to the overall project completion. You get the project percent complete by multiplying the weighted percent by the master activity percent complete (WIP) for each activity. Look at figure 2-25 master activity 20, underslab utilities. The project percent complete was determined by multiplying the weighted percent of 0.07 times the percent WIP of 80 to get a project percent complete of 5.6 (0.07 x 80 = 5.6).

Actual Percent Complete

Actual percent complete for the project is the total of the project 90 complete column. For the example in figure 2-25 the actual percent complete for this project is 14.2 percent. You will need to record the scheduled percent complete at the bottom of the SITREP feeder. You need to compare the actual progress to the scheduled progress. The scheduled percent complete comes from either the Deployment Execution Plan (within the first 45 days of the deployment) or the Revised Deployment Execution Plan (after the 45-day review). The allowable percent deviation between actual WIP and scheduled WIP is shown in table 2-3.

If the actual WIP is less than the scheduled WIP by more than the percentage shown in table 2-3, the battalion must advise 2ndNCB/3rdNCB by message. This message must contain a plan detailing how to get the project back on track. It must also request approval for any required changes to the battalion level I or the project level II in the revised deployment execution plan.

Man-days Remaining

Man-days remaining area reflection of how much work remains to be done on the project. **Man-days remaining has nothing whatsoever to do with how many man-days have been expended.** For master activities that are complete (see master activity 10, fig. 2-25) the man-days remaining are zero. For master

Table 2-2.—Master Activity Percent Complete

Construction Activity	Man-days Estimate	Weighted Percent	Percent Complete	Master Activity % Complete	Man-days Remaining	Man-days Expended
Prefab forms	6	.17	100	17	0	8
Prefab RST	7	.20	100	20	0	7
Set forms/RST	14	.40	50	20	7	8
Place concrete	5	.14	0	0	5	0
Strip forms	3	.09	0	0	3	0
	35	1.00		57	15	23

Table 2-3.—Percent Deviation

Total Project Man-day Range	Allowable % Deviation Btwn Actual WIP vs. Scheduled WIP
0 - 1000 MD	10%
1000 - 2000 MD	5%
2000 & above MD	2.5%

activities not started, the man-days remaining will equal the original man-day estimate for that master activity. For master activities under construction you must calculate the completion status of each individual construction activity. Construction activities that are 100 percent complete has zero man-days remaining. Construction that has not begun has man-days remaining equal to the original man-day estimate. If a construction activity with an original estimate of 20 man-days is 25 percent complete, the man-days remaining is 15. There are 15 man-days remaining because 75 percent of the work is left to be done and 75 x 20/100 equals 15.

Man-days Expended

Man-days expended have nothing to do with percent complete and are not included in the SITREP when it leaves the battalion. It is included on the SITREP feeder so the company staff and the Ops department can see where your man-days have gone. The man-days expended may be used for insight into why a particular project is behind. The total man-days expended is also needed to update the level II with actual progress and cumulative man-days expended.

Comments Lines

The SITREP feeder also has several lines for comments. This is for the crew leader's draft input for the SITREP. The battalion must include in its SITREP brief comments describing work performed since the last SITREP. Remember, if the actual WIP is less than the scheduled WIP, the delay must be explained and a plan for getting the project back on schedule must be included.

SITUATION REPORT (SITREP)

With the information from your SITREP input, the battalion can now formulate the situation report. A message SITREP must be submitted monthly by the battalion within 3 workdays after the last day of each month. The report includes all tasked projects listed in increasing numerical sequence. Once construction has started on a project, the project is considered as active and is not removed from the report until such time as the project has been accepted as totally complete by the RO1CC. Once a project has been completed, and a UCD/BOD (usable completion date/beneficial occupancy date) has been established, it may be deleted from future reports.

Project Status Summary

All SITREPs include a project status summary by location. This summary provides project WIP, remaining project man-days, and completion date percentage data. The status summary also contains a brief description of the work accomplished during the reporting period for each project. Each location must be detailed as a separate subparagraph. For projects for which no work was accomplished during the reporting period, the master activities status and activities reporting lines may be shown as no report. However, when no work is accomplished, the reason for a no work status must be adequately explained in the comments lines as part of the status explanation.

Change of Usable Completion Date (UCD)

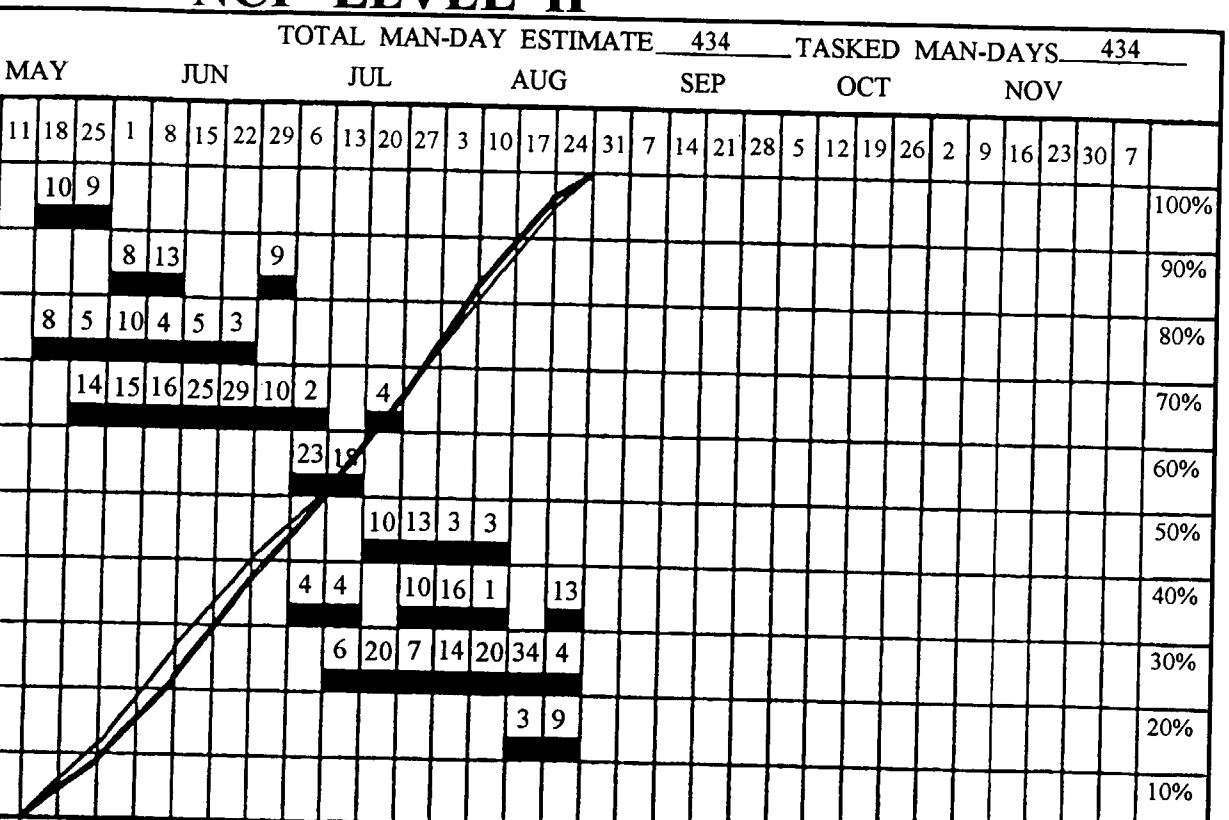
During the home port planning process, 2ndNCB/3rdNCB will discuss UCDs with the battalion as required. This discussion ensures that applicable information is considered when

NCF LEVEL II

PROJECT # _____
TITLE Admin Building

TOTAL MAN-DAY ESTIMATE 434 TASKED MAN-DAYS 434

ACT #	MASTER ACTIVITY	MDs	wt %
10	Sitework	19	4
20	U/S Utilities	30	7
30	Foundation/Slab	35	8
40	Walls/Canopy	115	27
50	Roof	41	9
60	Rough Utilities	29	7
70	Exterior Finish	48	11
80	Interior Finish	105	24
90	Finish Utilities	12	3
	Total	434	100



MDs Scheduled This Period	0	46	66	62	48	62	63	61	26
Cumulative Man-days Scheduled	0	46	112	174	222	284	347	408	434
% Complete Scheduled (Plot)	0	11	26	40	51	65	80	94	100
MDs Expended This Period	0	34	47	64	56	71	68	64	41
Cumulative Man-days Expended	0	34	81	145	201	272	340	404	454
% Man-days Expended	0	8	19	33	46	63	78	93	105
% WORK-IN-PLACE (Plot)	0	9	21	37	50	65	82	96	100

Figure 2-26.—Level II barchart with progress curve.

establishing the UCD. UCDs, except for specific projects with critical completion dates, are established by the battalion. When delay of a UCD becomes necessary, the battalion must advise 2ndNCB/ 3rdNCB in writing of the cause and estimated duration of the delay. The UCD reflected in the SITREP, however, shall not be adjusted until approved by 2ndNCB/3rdNCB. When adjusting UCDs, the battalion takes appropriate action to ensure that only the minimum number of UCDs are affected by the delay.

BARCHARTS

Barcharts are used to plot and track your progress as you work your project. They graphically show you if you are ahead, behind, or on schedule. Barcharts help you track how well you are doing against what you had planned. At the end of each month you need to update your level II barchart with the actual man-days expended and percent completed. To plot these figures, you need to total the man-days expended for direct labor (from your time cards) and obtain the percent complete from the SITREP. To make a progress curve you just connect the dots. If the progress curve is above the planned progress curve, your project is ahead of schedule; if below, you are behind. As previously stated, man-days expended have nothing to do with percent complete. However, a rough comparison can be made between the man-days expended as a percent of the total man-day estimate versus the scheduled percent complete. A large variation in these numbers indicates a problem. Figure 2-26 is a level II with an actual progress curve and cumulative man-days figures. This illustration shows all the information plotted through the end of the project.

PHOTOGRAPHIC COVERAGE

The battalion shall provide to 2ndNCB/3rdNCB on a monthly basis at least two color slides of each active project. These slides must arrive not later than the fifth of each month. Vantage points are chosen based on the broadest coverage. The same view should be used for slides taken during the following months. Consistency in vantage points and view help show sequence of construction. Include slides/prints of working crew members and major construction evolutions that depict Seabees in action. It is the crew leader's responsibility to produce photographic proof of the project's progress. Be sure the slides/prints show a commitment to a quality product, teamwork, and zero safety violations.

SAFETY

The battalion safety office is not responsible for safety on your jobsite. **YOU ARE!!!** According to the *NCF Safety Manual,* COM2NDNCB/COM3RDNCB-INST 5100.1 series, the battalion safety office administers the battalion safety program and provides technical guidance. It is the crew member, the crew leader, the project supervisor, the company chief, the company commander, the Ops officer, and the commanding officer who are 100 percent responsible for safety on the jobsite. If you have any questions concerning safety on the project, the battalion safety office is a good place to get your questions answered. It is not the responsibility of the safety office to prevent you from doing something you know or suspect is unsafe. They do not have the staff to be present on the jobsite at all times. Safe construction is your responsibility, and ignorance is no excuse. It is your responsibility to find out how to do construction in a safe manner.

MISHAP PREVENTION

The goal of our safety program is to prevent mishaps. Seabees do not use the word *accident* because it implies the absence of fault (accidents happen). Mishaps most commonly result from failure to follow safe construction practices. Consider an activity to replace the deck on a marina pier. Follow the seven-step process in figure 2-27 to see how you can best avoid a mishap.

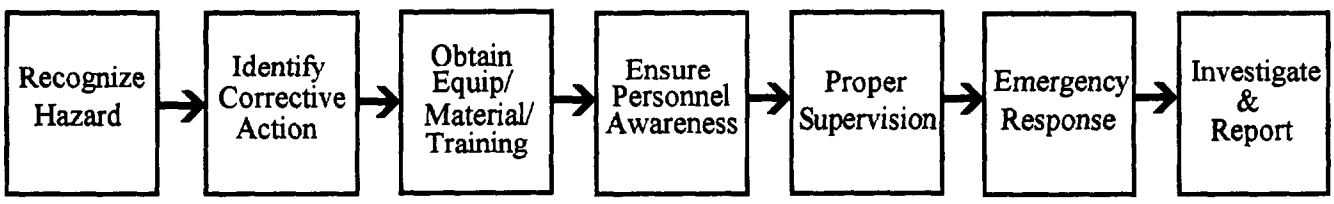


Figure 2-27.-Seven steps to avoid a mishap.

Recognize Hazards

Begin by recognizing that construction is a dangerous business. The potential for death or serious injury is present daily on jobsites. Identify very specifically what hazards could cause death or injury. One obvious hazard in the pier example is drowning.

Identify Corrective Action

Our primary reference for preventive measures is the *U.S. Army Corps of Engineers Safety and Health Requirements Manual,* EM 385-1-1, October 1992. The table of contents, section 5, addresses work near water. In chapter 5, specific requirements for work safety near the water include the following:

— A U.S. Coast Guard-approved international orange personal flotation device (PFD) type III, type V, or better vest must be provided to and worn by persons on structures extending over or adjacent to water unless guardrails or safety nets are in place.

— The PFD must be inspected for defects before and after each use.

— Ring buoys, conforming to 46 CFR 160 (U.S. Coast Guard-approved), with 90 feet of 3/8-inch solid braid polypropylene (or equal) attached, must be provided at intervals of not more than 200 feet on piers extending over or immediately adjacent to water.

— At least one equipped skiff must be immediately available at locations where employees are working over or immediately adjacent to water.

— Personnel trained in launching and operating the skiff must be readily available during working hours.

Obtain Equipment/Material/Training

The Ops department and safety office will provide assistance in obtaining the PFDs, the buoys, and the skiff. The customer may be persuaded to provide unavailable equipment, or the equipment will have to be purchased/rented using project funds. Training for the crew in operating the skiff maybe required and the Ops and training departments will assist in setting up this training.

Ensure Personnel Awareness

Use the daily 5-minute stand-up safety lecture to ensure the crew understands the proper use and purpose of the safety equipment and the locations of the buoys and the skiff. Safety lectures must address all hazards identified on the CAS sheet for work scheduled that day. Remember to inspect the PFDs before and after each use.

Proper Supervision

The crew leader is responsible for ensuring that personnel wear PFDs at all times while on the pier.

Emergency Response

To be sure that an emergency response is not delayed, the location of the nearest phone, a map showing the nearest medical facility or first-aid station, and all emergency phone numbers must be posted on the jobsite.

Investigate and Report

Any mishap (regardless of how minor) or near miss must be investigated and documented. Documentation helps minimize the chance that an incident will happen again. Figure 2-28 is the form used for the supervisor's report of injury.

SAFETY RESPONSIBILITIES

The safety responsibilities for various levels in the chain of command are listed in the *NCF Safety Manual.*

Crew Leader's Responsibilities

Crew leaders and other supervisors are identified in the *NCF Safety Manual* as the key people in a successful and aggressive safety program. The *NCF Safety Manual* lists but is not limited to the following responsibilities:

— Being familiar with safety rules and regulations for jobs and facilities in his/her area, and acting in a safe manner.

— Enforcing safety rules and correcting unsafe acts.

— Inspecting jobs and work areas for hazards and taking corrective action.

SUPERVISOR'S REPORT OF INJURY

Name of injured: _____

Injury date: _____ Time: _____

Number of light duty days: _____

Nature of injury: _____

Where and how did the accident occur? _____

_____

_____

_____

Unsafe act or condition: _____

_____

_____

_____

Measures taken to prevent a similar type of accident: _____

_____

_____

_____

_____

_____

_____

_____ _____

Crew leader Date

Figure 2-28.-Supervisor's report of injury.

— Educating and training personnel in safe work procedures and rules.

— Reporting all mishaps and near-mishaps to the safety office promptly.

— Ensuring personnel that need medical treatment receive prompt care.

— Investigating all mishaps in his/her area, determining basic causes, taking corrective action, and requesting assistance from the safety office when necessary.

— Reviewing safety and health records of employees and facilities in his/her area as required.

— Taking corrective action on reported hazards and protecting employees from reprisal of hazard reporting.

— Ensuring that correct personal protective equipment is provided to personnel and that they wear and maintain the equipment properly.

— Obtaining advice and assistance from the safety office in the positive implementation of the NAVOSH program.

— Knowing the limitations of subordinate personnel and avoiding hazardous job assignments to personnel who are not physically and/or mentally capable of safely performing work assignments.

— Removing from service any defective machinery, material, or tools until repairs can be made to assure safe operation.

— Posting appropriate safety precaution signs in conspicuous areas near or on equipment, material, stowage areas, and other designated hazards or hazardous areas.

Crew Member's Responsibilities

Crew leaders should ensure that each crew member understands the responsibilities listed in the *NCF Safety Manual.*

— Knowing, understanding, and complying with the safety rules and regulations applicable to their assigned work and work area.

— Reporting to the work site rested and emotionally prepared for the task at hand.

— Understanding and adhering to safety and health precautions applicable to their work and work areas.

— Reporting to their immediate supervisor any unsafe conditions including unusual or developing hazards or any materials that may be considered unsafe.

— Cautioning those who may be endangered by suspected, known, unusual, or developing hazards.

— Reporting to the immediate supervisor any mishap, injury, or evidence of impaired health.

— Using all protective equipment and/or clothing of the type required, approved, and supplied for the safe performance of the task at hand.

— Ensuring that clothing worn is appropriate for work assigned. Jewelry or loose scarves shall not be worn when they subject the individual to a potential hazard.

— Ensuring that hair and beards are suitably restrained around hazardous machinery and open flames.

PROJECT SAFETY PLAN

For each construction activity, all identified hazards and corrective actions are listed on the back of the CAS sheet. The safety plan (fig. 2-29) lists the hazards and corrective action from the back of the CAS sheets. A cover sheet (fig. 2-30) for the safety plan summarizes the training and equipment required for review by the chain of command. The project safety plan must be posted on the jobsite. A daily jobsite safety inspection (fig. 2-31) is performed by safety office personnel.

STAND-UP SAFETY LECTURES

The key to mishap prevention is personnel awareness. Personnel awareness is the purpose of the daily stand-up safety lecture. Use the form in figure 2-32 to document the daily stand-up lectures. It is **not** enough to anticipate the hazard and provide protective equipment. The crew leader must ensure that the crew is properly trained and motivated to use the equipment properly. If the corrective action includes specific procedures or methods, the crew leader must make sure those procedures are followed **every** time. Never let a member of your crew get lackadaisical! Make

SAFETY PLAN

PROJECT NUMBER _____ PROJECT TITLE _____ DATE _____

ACTIVITY NUMBER	ACTIVITY DESCRIPTION	HAZARD	REF.	ACTION REQUIRED	PAGE NUMBER

Figure 2-29.-Safety plan.

sure the crew knows the safe way to perform the task at hand, and then accept nothing less than 100 percent compliance. Working safely 99.9 percent of the time is **not** enough. One shortcut can kill!

SAFETY TRAINING

The following safety training is required by the *NCF Safety Manual* for the identified crew personnel.

NCF Supervisory Safety Course

There is a 40-hour course taught by Naval Construction Training Center (NCTC) or the battalion safety chief. Attendees are familiarized with the safety program, the use of safety manuals, identification of construction hazards, and the inclusion of safety in project planning. All E5-E7 personnel in line companies and detail, all project safety representatives, and all crew leaders are required to attend.

Hazard Recognition/Mishap Prevention Course

A 16-hour course taught by the battalion safety chief familiarizes working level personnel with common hazards and safe work practices. Project safety representatives and crew leaders who have not attended the NCF Supervisory Safety Course are required to attend this course.

ELECTRICAL SAFETY

All jobsite electrical supplies are considered to be temporary power sources. Even existing outlets in buildings being renovated are temporary power sources. All temporary power sources must be inspected, certified as safe, and tagged with the inspector's name, company, and date before first use. Recertifications are required every 2 weeks thereafter. Ground fault circuit interrupters (GFCIs) must be used with all power tools, whether double insulated or not.

COVER SHEET FOR PROJECT SAFETY PLAN

I. Project Name and Number

II. Project Location

III. Prime Contractor
Sub-Contractors (a)
(b)

IV. Project Scope

V. Type of Inherent Risks (electrical, welding, etc.)

VI. Type of Associated Risk (fire, fumes, noise, etc.)

VII. Special Training Requirements

VIII. Special License Required

IX. Engineering Controls (guard rails, welding curtains, etc.)

X. Special Safety Equipment Required (state how it is to be used)

XI. Personal Protective Equipment Required

XII. Safety Standards/Restrictions Pertaining to Project Scope

Project Planner: _____
Print name, rate and company/det

Safety Chief: Approved/Disapproved _____
Signature

Reason for disapproval _____
_____

Figure 2-30.-Cover sheet for project safety plan.

SAFETY INSPECTOR'S REPORT

Report No.		
Route to:	Initial	Date

Date	Time	Project No.
Prime Co.		Project Title
Sub Co.		Weather
Crew leader		Inspector

	Yes	No		Yes	No
1. Safety lecture given (subject)			12. Welding		
2. GFI protection on project			13. Monthly PM for elect. tools		
3. Personal protective equipment in use?			14. Electrical boxes		
			15. Tool storage area		
4. Fire Extinguishers			16. Hand tools (saw, chisel, etc.)		
5. Flammable liquid stored properly			17. Excavation (shoring, permits)		
6. First-aid kits on project			18. Hard hats worn		
7. Good housekeeping			19. Crew leaders using safety plan		
8. Ladders - safe condition & use			20. Open floor holes covered		
9. Scaffolding - safe condition & new			21. Wall openings guarded		
10. Portable radial saw condition			22. Tripping hazards present		
11. Area sanitation			23. Other		

CRANE SAFETY

1. Who inspected the rigging used for lift (required daily)?
2. Are the proper barriers in place behind the crane?
3. Are tag lines used on the load?
4. Is the crane certified (check with the operators)?
5. Who is the crane director?

SAFETY HAZARD	ACTION TAKEN

Note: Action taken on repeat discrepancies must be submitted in writing to the safety office within three working days after receiving report

Safety Inspector _____ Crew leader _____

Figure 2-31.-Safety inspector's report.

From: Crew Leader Project No._____
To: Battalion Safety Chief

Subj: DAILY FIVE-MINUTE SAFETY LECTURES FOR THE DATES_____ THROUGH_____

Date	Topic of Safety Lecture	Instructor	Location	Rates	Number of Men

Figure 2-32.—Daily stand-up safety lecture form.

All electrical portable tools, extension cords, small gasoline, pneumatic, and power-actuated tools (including those borrowed from other units) must be inspected monthly and tagged with the safety color of the month. Equipment or circuits that are de-energized shall be tendered inoperative and have tags attached at all points where such equipment or circuits can be energized. Refer to 29CFR1910. 147 and ANS1 Z244.1 for lockout/tag-out procedures.

ASBESTOS OPERATIONS

Asbestos removal is not normally conducted by NCF personnel. COM2NDNCB/COM3RDNCBINST 5100 series gives detailed guidance on NCF asbestos policy and procedures.

RESPIRATORY PROTECTION

All of the following requirements must be met prior to the use of respirators:

- Correct equipment identified by the local Respiratory Protection Program manager
- Medical evaluation of potential users
- Fit test performed by competent personnel
- Respiratory protection training for all potential users
- Written standard operating procedures (SOPs) developed for the work site, including emergency and rescue guidance, and posted on the jobsite

SHORING

The following excerpt is taken from the EM 385-1-1:

> Banks more than 5 feet high shall be shored, laid back to a stable slope, or provided with other equivalent protection where employees may be exposed to moving ground or cave-ins.

Trenches less than 5 feet in depth shall also be protected when examination of the ground indicates hazardous ground movement may be expected. The safe angle of repose for soil conditions and bracing systems shall be determined by a qualified person.

Refer to the EM 385 for specific details. All excavations must follow 29CFR1910.28, OSHA Standards.

SCAFFOLDING

Here is a general listing of scaffolding requirements (for a complete list see the EM 385 and 29CFR1910.28):

- Scaffolds or platforms are required for all work that cannot be done safely from the ground.
- Work requiring lifting of heavy materials or substantial exertion cannot be done from ladders.
- Scaffolds must be kept clear of ice, snow, grease, mud, and such.
- All scaffolds and walkways must beat least 18 inches wide.
- Ladder jacks, lean-tos, and prop scaffolds are prohibited.
- Scaffolds must be placed on a firm, smooth foundation and may not be placed on loose bricks, blocks, or other unstable objects.
- Nails must be driven full length; double-headed nails are not allowed.
- Planking must be lapped at least 12 inches.
- The EM 385 and 29CFR1910.28 list the correct dimensions and type of scaffold material.
- A scaffold in excess of 6 feet in height (4 where horizontal dimension is less than 45 inches) requires standard railing on open sides and ends.

SAFETY ITEMS REQUIRED ON THE JOBSITE

The following safety equipment is required on all project sites. See the EM 385 for additional information.

1. **Emergency Plans—** Each jobsite must have posted the location of the nearest phone with the telephone numbers and reporting instructions for ambulance, hospital, physician, police, and fire department personnel.
2. **First-Aid/CPR Qualified Personnel —** If a medical facility is not readily accessible (due to time or distance), two crew members must be first-aid and CPR qualified.
3. **First-Aid Kits—** There must be one kit for every 25 or less personnel, and it must be checked weekly for consumed items.
4. **Toilet Facilities—** If toilet facilities are not readily available, portable facilities must be provided.
5. **Drinking Water—** Water must be provided from an approved source. It must be labelled for drinking only and not used for other purposes. Common cups are not allowed.
6. **Temporary Fencing—** If the jobsite is in an area of active public use, temporoary fencing is required.
7. **Warning Signs—** Post red for immediate hazards and yellow for potential hazards.
8. **Eyewash Facility —** Where personnel are exposed to or handling poisons, acids, caustics, or toxic chemicals, eyewash facilities are required.
9. **Fire Extinguishes —** There must be one approved fire extinguisher for every 3,000 square feet (or major fraction thereof) of building space with at least one per floor.
10. **Material Safety Data Sheets —** This paper work is required for any hazardous material on the jobsite.
11. **Safety Manuals—** Both the EM 385 and 29CFR1926 are required to be kept on the jobsite.

PROJECT CLOSEOUT

This section will assist the crew leader in completing operational and administration steps when the project comes to a close. This section also will assist you with the preparations for your final inspection.

TOOL, EQUIPMENT, AND MATERIAL TURN-IN

The crew leader must ensure the jobsite is clean! All tools, excess material, and civil engineering support equipment (CESE) must be properly **cleaned,** inventoried, and returned to the proper outlet. Tools and tool kits returned to CTR must be inventoried with 1250-1s filled out for any missing or broken items. Turn all material into MLO using a 1250-1 filled out in red ink with the appropriate bill of material line item number. Project material as well as tools purchased with project funds must be offered to the customer prior to being considered "excess."

PRE-BOD INSPECTION REQUEST

Project No:	Crew leader:	Date:

This inspection is conducted prior to the final acceptance (BOD) inspection. This "pre-BOD" inspection is conducted jointly with battalion and ROICC representatives and is intended to identify any corrective steps necessary prior to customer occupancy.

Requested Date:	Time:	Requested by: (name/rate)

The following checklist shall be completed by the crew leader and forwarded to QC two working days prior to the requested date of the inspection. The crew leader should use the following checklist as guide but the pre-BOD inspection will not be limited to these items.

	crew leader init.
SITEWORK	
Final Grading (Grassing)	
Disposal of all Trash	
Sidewalks	
Curbs & Paving	
Lights	
MECHANICAL	
Installation of Piping, Fixtures and Equipment	
Application of Insulation and Hangers	
Sterilization (Water System)	
Shop Drawings	
Water Supply Test	
Gas & Oil Piping	
Heating and Cooling Units	
Duct Work	
Thermostat Controls	
Registers	
Exhaust Fans and Hoods	
Manufacturers' Catalogs	
Working Test (Boilers)	
ELECTRICAL	
Manufacturers' Catalog	
Test All Lights	
Test Fire Alarms	
Telephone Hook-up	
Main Panel Box (All Breakers Labelled)	
CONCRETE & MASONRY	
Joints	
Cracks	
STRUCTURAL STEEL	
Touch-up Paint	

Figure 2-33.—Pre-BOD inspection request (page 1).

AS-BUILT DRAWINGS

During construction, the crew leader must keep all prints updated and every 2 weeks check with the engineering department to make sure they are making the same updates. At the close of the project, the battalion is required to turn in two sets of as-built (red-line) drawings to the ROICC. These drawings show how the project was actually constructed.

PRELIMINARY ACCEPTANCE

At the completion of your project use the pre-BOD checklist (fig. 2-33, page 1, and fig. 2-34, page 2) to

HARDWARE	Crew leader init.
Closet	
Bathroom Accessories	
Door Hardware	
Gate Hardware	
Miscellaneous Hardware	
DOORS & WINDOWS	
Clean	
Fit	
FINISHES	
Acoustic Tile	
Ceramic & Quarry Tile	
Floor Covering	
Painting	
Plastering	
FURNISHINGS	
Fabrication	
Installation	
GENERAL	
Project Package Up to Date	
As-Builts Completed	
Site Clean	
Excess Material Turned-in	
REMARKS	
Crew leader	QC Inspector

Figure 2-34.-Pre-BOD inspection request (page 2).

make sure your project is ready. Arrange, through your QC staff, for a preliminary acceptance inspection with the ROICC. After this inspection, the battalion will take the necessary actions to complete any punchlist items. The battalion will complete these items as soon as possible. The punchlist should be provided in writing from the ROICC following the inspection similar to figure 2-35.

FINAL ACCEPTANCE

In most cases the project will not be turned over to the customer until all of the punchlist items have been completed. When all of the punchlist items have been completed, the crew leader will arrange through the QC for a final inspection with the ROICC and a customer representative. There should be no punchlist at this

COMMAND LETTERHEAD

Date:

MEMORANDUM

From: ROICC
To: NMCB

Subj: Project XXX-XXX

1. A preliminary inspection was conducted at 1500H on 30 January 1994 for the subject project. The following personnel were present:

2. As a result of the inspection, the following discrepancies were noted:

_____
Signed

Copy to:
2nd NCB/3rd NCB

Figure 2.35.-Punchlist from ROICC.

inspection. If there are no discrepancies, beneficial occupancy is established upon completion of the final inspection and the 1-year warranty takes effect. At this time, the battalion prepares a letter to the ROICC advising that the project has been completed. This transfer letter shall include two sets of as-built drawings, all installation, operation, maintenance, and other technical service manuals, including parts catalogs. The transfer letter also must include a statement of actual material cost and statistical labor costs. Figure 2-36 is a sample of the transfer letter. If the ROICC did not include 2ndNCB/3rdNCB on the distribution of their acceptance letter, the battalion will forward a copy. The ROICC acceptance letter is placed in the project files. The project files are then closed and retained for 2 years.

COMMAND LETTERHEAD

DATE: _____

From: NMCB
To: ROICC

Subj: PROJECT XXX-XXX

1. A final inspection was held for subject project on (date) with the following personnel in attendance:

NAME	ORGANIZATION
_____	_____
_____	_____
_____	_____
_____	_____

2. As no discrepancies were noted during the final inspection, NMCB___'s tasking is hereby considered complete. The one year warranty commenced (same date as inspection).

3. As-built drawings and maintenance manuals for installed equipment are provided as enclosures ( ) through ( ).

4. The total material cost was &____and the total labor cost was $___.

_____
BATTALION REPRESENTATIVE

Figure 2-36.-Project transfer letter.